NORMAN A. JOHNSON
Editor

CHARLES A. WHITEHEAD
Managing Editor

MYRON D. REESER
Business Manager

HERBERT A. STAUDERMAN
Advertising Manager

JAMES A. DOYLE
Promotion Manager

WILLIAM J. O'CONNOR
Production Manager

BERYL A. LAKNER
Circulation Manager

OFFICIAL PUBLICATION OF THE PROCEEDINGS, AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS

American Dyestuff Reporter was founded in 1917 and the Textile Colorist and Converter (formerly Textile Colorist) was incorporated with it in January, 1949. Published every other Monday, by the **HOWES PUBLISHING COMPANY, INC.**, 44 East 23rd Street, New York 10, N. Y. **C. R. Howes**, President; **Ernest J. Finan**, Executive Vice-President; **Norman A. Johnson**, Vice-President & Treasurer; **Myron D. Reeser**, Vice-President; **C. Essenbreis**, Secretary.

Telephone SPring 7-9364

AMERICAN
DYESTUFF REPORTER
DEVOTED TO TEXTILE WET-PROCESSING

contents

VOLUME 46 March 25, 1957 NUMBER 6

aatcc proceedings

feature articles

The Application of Colorants to Glass Fiber Textiles P195
R F Caroselli
A Century of Progress in the Development of Colorfastness Test Methods for Textiles ... P199
M L Staples

miscellaneous

Piedmont Section to Host Council, National Committee Meetings P193
AATCC Calendar P194
Future Papers P194
Employment Register P211
Activities of the Local Sections P212
Notice to Authors of Papers P213
Letter to the Editor P214
Membership Applications P214
Colour Index Notice P215
Organization of the AATCC P220

departments

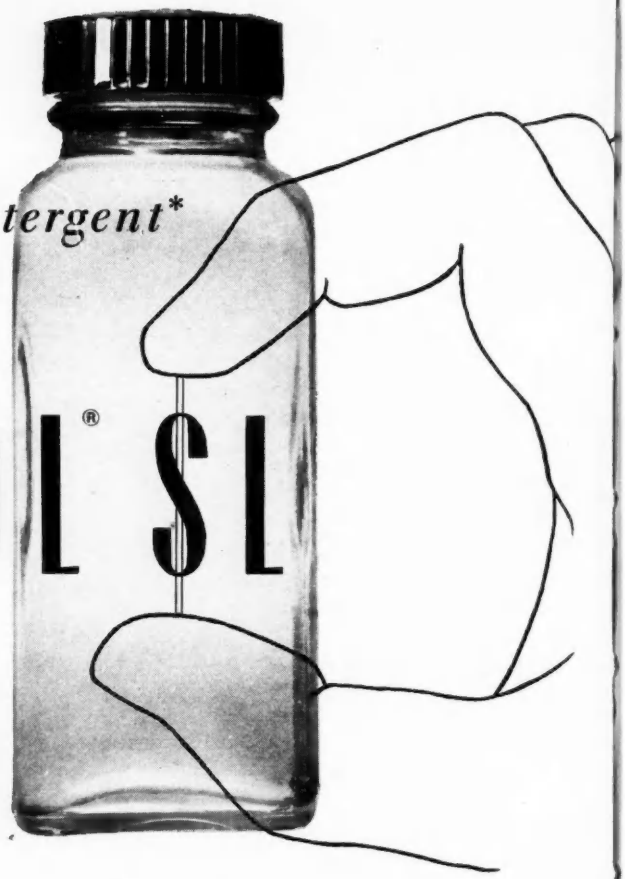
Patent Digest 221
Paul Wengraf
Book Review 223
Abstracts 224
News of the Trade 227
New Products and Developments 230
General Calendar 230
Names in the News 231
Technical Literature 232

Copyright, 1957, Howes Publishing Co, Inc
Contents of previous issues can be found by consulting the Industrial Arts Index and the Engineering Index, Inc. at your library

largest-selling liquid detergent in the textile industry...*

NACCONOL® SL

...because it helps ease the pinch on profits!



When profit margins are tight, production costs must be watched. That's why so many economy-minded textile mills use Nacconol SL.

They have found that Nacconol SL gives more cleaning power per dollar, as compared with most dry products on the basis of active-ingredients.

Liquid Nacconol SL cuts handling time and costs, too. It's cleaner and easier to use. Nacconol SL needs no dissolving. You simply add water to make the required working concentration.

Other popular forms of Nacconol for wet processing include Nacconol DB, Nacconol NR and Nacconol NRSF. Contact the nearest office for prices, samples and technical help.

*Alkyl Aryl Sulfonate

Nacconol

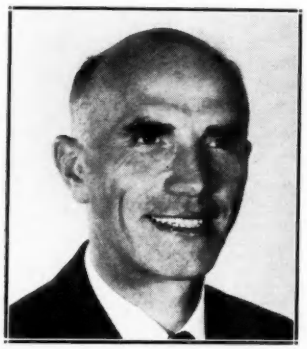
NATIONAL ANILINE DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 RECTOR STREET, NEW YORK 6, N.Y. • HAnover 2-7300

Akron, Ohio, First Federal Savings Bldg. BLackstone 3-9324
Atlanta, Ga., 1216 Spring St., N. W. TRinity 6-0368
Boston 14, Mass., 150 Causeway St. CApitol 7-0490
Charlotte 1, N.C., 201-203 West First St. EDison 3-9221
Chattanooga 2, Tenn., 1203 James Bldg. CHattanooga 6-6347
Chicago 54, Ill., The Merchandise Mart MIchigan 2-1000
Columbus, Ga., Columbus Interstate Bldg. Columbus 7-4512
Greensboro, N.C., Jefferson Stand. Bldg. GReenbare 2-2518
Los Angeles 58, Cal., 4814 Loma Vista Ave. LOgan 8-2257
New Orleans 12, La., Carondelet Bldg. Raymond 7278
Philadelphia 6, Pa., 200-204 S. Front St. LOmbard 3-6382
Portland 9, Ore., 730 West Burnside St. Beacon 1853
Providence 3, R.I., 15 Westminster St. DExter 1-3008
Richmond 19, Va., 8 North Fifth St. Richmond 2-1930
San Francisco 4, Cal., 235 Montgomery St. YUkon 2-4840
Toronto 14, Can., 100 North Queen St. E. BEImont 3-6278

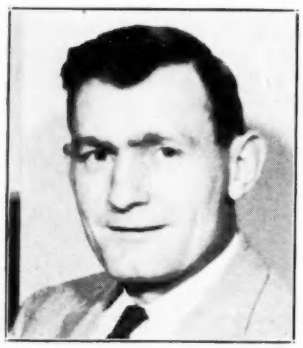
Allied Chemical

Proceedings of the
American Association of Textile Chemists and Colorists
Copyright, 1957, American Association of Textile Chemists and Colorists
MARCH 25, 1957

PIEDMONT SECTION TO HOST COUNCIL, NATIONAL MEETINGS



Sylvester



Wham

Smith

AT the invitation of the Piedmont Section, the Council and National Committees of AATCC will meet this week in Roanoke, Va, in conjunction with the Section's Spring Meeting.

Committees of the Council will meet afternoon and evening on Thursday, March 28.

The following day, Research Committees of the Technical Committee on Research will meet morning and afternoon. The Council will meet at 2 pm.

Meetings of the National Research Committees will continue on Saturday morning, with the regular TCR luncheon slated for 12:30 pm.

The Saturday afternoon program calls for a technical session, sponsored by the Piedmont Section, at 2 pm. At this session Dr Irving A Berstein, Tracerlab, Inc, will speak on "The Use of Radio-active Tracer Chemicals in Wet Processing".

In place of its regular technical session, TCR will take over the second half of the Saturday afternoon program and have chairman of selected committees of special interest to the South give reports on the activities of their respective committees. Following opening remarks by Charles A Sylvester, chairman, TCR; George O Linberg, president, AATCC; and Harold W Steigler, director of research, AATCC; the following chairmen will speak: George S Wham, Jr, Good Housekeeping Institute, "Wash and Wear"; Ralph B Smith, New Jersey Laundry and Drycleaning Institute, "Colorfastness to Washing"; Joseph E Norton, Atlas Electric Devices Co, "Colorfastness to Light"; Richard F Aurich, Joseph Bancroft & Sons, Co, "Damage Caused by Retained Chlorine"; and John H Warner, D B Fuller & Co, Inc, "Dimensional Changes in Textile Fabrics".

Featured speaker at the Piedmont Section's Saturday night banquet will be Dave Morrah, noted author, cartoonist and humorist, who will discuss "Humor in Industry".

Norton

Aurich

Warner

AATCC Calendar

COUNCIL

Mar 29 (Hotel Roanoke, Roanoke, Va); June 7 (New York)

NATIONAL CONVENTIONS

Nov 14-16, 1957 (Hotel Statler, Boston); Oct 30-Nov 2, 1958 (Hotel Conrad Hilton, Chicago); 1959 (Sheraton Park and Shoreham Hotels, Washington, D C); Oct 6-8, 1960 (Sheraton Hotel, Philadelphia, Pa); 1961 (Buffalo, NY)

DELAWARE VALLEY SECTION

April 5 (Ladies Night—Benjamin Franklin Hotel, Philadelphia, Pa); May 24 (Outing—Torresdale-Frankford Country Club, Philadelphia, Pa); Sept 27 (Joint meeting with New York Section at Trenton, NJ); Nov 1 (Sheraton Hotel, Philadelphia, Pa); Dec 6 (Kugler's Restaurant, Philadelphia, Pa)

HUDSON-MOHAWK SECTION

Mar 29 (Johnstown, NY); May 17 (Ladies Nite—Schuyler Meadows, Albany, NY); June 21 (Outing—Antlers Country Club, Amsterdam, NY)

MID-WEST SECTION

April 27 (Netherland Hilton Hotel, Cincinnati, O); June 14-15 (Outing—Brown's Lake Resort, Burlington, Wis); October 26 (Bismarck Hotel, Chicago, Ill)

NEW YORK SECTION

Apr 26, May 24—ladies nite (Kohler's Swiss Chalet, Rochelle Park, NJ); June (Annual Outing)

NIAGARA FRONTIER SECTION

Apr 5 (Joint meeting with CATCC at Kitchener, Ont)

NORTHERN NEW ENGLAND SECTION

May 10 (Lowell Tech Inst, Lowell, Mass); Sept 13 (Outing—Wachusett Country Club, W Bolyston, Mass); Dec 6 (Annual meeting, Hotel Continental, Cambridge, Mass)

PIEDMONT SECTION

Mar 30 (Hotel Roanoke, Roanoke, Va); June 7-9 (Outing—Mayview Manor, Blowing Rock, NC); Sept 28 (Hotel Barringer, Charlotte, NC)

RHODE ISLAND SECTION

Mar 28 (Providence Engineering Society, Providence, RI); Apr 25 (Student Night—New Bedford ITT, New Bedford, Mass); June 14 (Outing—Warwick CC and Rocky Point, RI); Sept 27 (Ladies Night—Narragansett Hotel, Providence, RI); Oct 24 (Prov Eng Soc) Dec 5 (Annual Meeting—Johnson's Hummocks Grill, Providence, RI)

SOUTH CENTRAL SECTION

Apr 27 (Hotel Patton, Chattanooga, Tenn); June 21-22 (Outing—Lookout Mtn, Tenn); Sept 20 (Hotel Patton)

SOUTHEASTERN SECTION

Apr 13 (Legion Hall, Lindale, Ga); June 7-9 (Outing—Radium Springs, Ga); Sept 14 (Harmony Club, Columbus, Ga); Dec 7 (Dinkler Plaza Hotel, Atlanta, Ga)

WESTERN NEW ENGLAND SECTION

May 17 (Ladies Night—Waverly Inn, Cheshire, Conn); June 14 (Outing—Wallingford, Conn); Sept 27 (Rapp's); Nov 1 (Annual meeting—Hartford area); Dec 13 (Rapp's)

Papers presented at the Perkin Centennial under AATCC sponsorship:

"The Development of Fast Colors for Textiles"—F M Fordemwalt, American Cyanamid Co

"The Development of Modern Textile Dyeing Techniques"—P L Meunier, E I du Pont de Nemours & Co, Inc

Papers presented before local sections:

"Lighting Factors to be Considered in Textile Color Matching"—Warren B Reese, Macbeth Daylighting Corp

"Binders for Nonwoven Fabrics"—Neil H Sherwood, B F Goodrich Research Center

"Technology of Nonwoven Fabrics"—L G Lovin and L P Wenzell, Celanese Corp of America

"Developments of Science and Industry in the South"—Frank J Soday, The Chemstrand Corp

"Random Tumble Pilling Tester"—A G Scroggie, E I du Pont de Nemours & Co, Inc

"Recent Developments in Vat Dyeing"—J M Fletcher, E I du Pont de Nemours & Co, Inc

"Fluorescent White Dyes: How They Work and How They are Evaluated"—Eugene Allen, American Cyanamid Co

"The New Look in Military Purchasing and Distribution of Textiles"—Victor J MacLaughlin, U S Army

"Frontiers in Fabrics and Finishes"—T J Seery, Dept of the Navy

"How Atomic Warfare has Changed Army Requirements for Textiles"—S J Kennedy, US Army Quartermaster Corps

Future Papers

The following material has been submitted to date to the publishers of American Dyestuff Reporter. Subject to the approval of the AATCC Publications Committee, it will appear in the Proceedings in future issues.

Authors, section officials, and committee chairmen are requested to inspect this list and notify the publishers if there are any omissions.

"Changing Trends in Requirements for Parachute Textile Materials"—J H Ross, Wright Air Development Center

"Automotive Fabrics: Factors Which Affect Lightfastness"—C H A Schmitt, Sandoz, Inc

"Dyeing of Synthetic Fibers"—S G Turnbull, Jr, E I du Pont de Nemours & Co, Inc

Miscellaneous:

"Leucoesters of Vat Dyestuffs"—Hans Luttringhaus, Progressive Color & Chemical Co

Review of the activities of the AATCC Committee on Damage Caused by Retained Chlorine for the period 1953-1956—L L Walmsley, American Viscose Corp

Other Perkin Centennial Papers

"The Standard Depths of Shade in Relation to the Assessment of Colorfastness of Dyes on Textiles"—Paul Rabe, Farbenfabriken Bayer AG

"Dyes and Dyeing Processes for Special Properties of Color"—J S Kirk, General Dyestuff Co

"Progress in Measuring Color Difference"—G W Ingle, Monsanto Chemical Co

"The Use of Color in National Defense"—S J Kennedy, Quartermaster Research and Development Command

"Seeing Light and Color"—Ralph M Evans, Eastman Kodak Co

"The Chemistry of Organic Pigments"—A Siegal and W S Struve, E I du Pont de Nemours & Co, Inc

"Color in Relation to the Political and Economic History of the Western World"—S M Edelstein, Dexter Chemical Corp

"Color in Ancient Times"—Earle R Caley, Ohio State Univ

"Color Designation through the Ages"—Ernest R Kaswell, Fabric Research Laboratories, Inc

"Early Synthetic Dyes"—Hans Z Lecher, consultant

"Synthetic Dyes for Cotton"—D I Randall, General Aniline & Film Corp

"Dyes for Animal Fibers"—James Ogilvie, National Aniline Div

"Dyes for the Hydrophobic Fibers"—H E Schroeder and S N Boyd, E I du Pont de Nemours & Co, Inc

"Fluorescent White Dyes"—Robert S Long, American Cyanamid Co

"The Theory of Dyeing Cellulosic Fibers"—Emery I Valko, Onyx Oil & Chemical Co

"Theory of Dyeing Polyester and Polyacrylic Fibers"—W R Remington and H E Schroeder, E I du Pont de Nemours & Co, Inc

Perkin Centennial———

THE APPLICATION OF COLORANTS TO GLASS FIBER TEXTILES*

R F CAROSELLI

Manager, Textile Product Development Laboratory
Owens-Corning Fiberglas Corp
Ashton, RI

INTRODUCTION

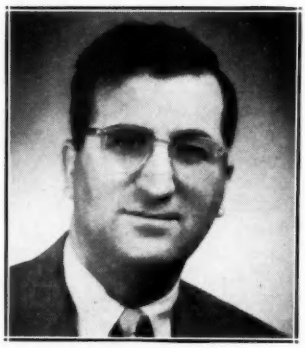
AS A representative of the fibrous glass industry I want to express the homage and appreciation of our group for the magnificent genius of Sir William Henry Perkin. Certainly our industry owes a great and long standing debt to this early pioneer.

His impact upon our work is dramatically illustrated by the many wondrous colors we are able to impart to many of our products. We are also indebted to him for the dynamic technology which he represented—the quality that takes an individual beyond the point of discovery and into a recognition of and belief in the wide commercial application of his work.

Remember that Perkin was only eighteen when he accidentally discovered mauveine. Yet he recognized almost instantly the full potential of his discovery! Within four months the young man had his patent; within a year he had begun construction of a plant; and within twenty months commercially manufactured mauveine was in use as a dyestuff. This is a tempo that would be highly respected in modern industry. A hundred years ago, it was an awe-inspiring pace, but one for which I'm sure we are all thankful.

DISCUSSION

We are proud that the qualities which have made glass indispensable to chemical researchers throughout the years are the same qualities that today, in glass yarns, are making valuable contributions to the textile field. From the simple glass beaker which held the world's first synthetic dye to today's decorative glass fabrics, the fibrous glass industry has played a dramatic role in realizing Sir Perkin's dream of "the more colorful world."



R F Caroselli

This is a discussion of the application of color to glass curtain and drapery materials. The main emphasis is placed upon various resin pigment systems and their effects on the soil resistance, fireproofness, washfastness, lightfastness, sewability, wrinkle recoverability, abrasion resistance, appearance, and general performance of glass decorative fabrics. The chemistry of dyeing, finishing, and printing as well as processing techniques are covered. A general study of the Coronizing process is presented as well as comparisons with the properties of other textile decorative fabrics. An additive for print systems which will permit printing, either roller or screen, on piece-dyed fabrics or fully finished white print goods without the need of subsequent finishing is also described. In addition, recent advances which have led to a reduction in the number of processing steps necessary to properly finish and dye glass fabrics are explained.

We in the glass textile field see in the glass beaker a symbol—a symbol of an approach, a faith, a hard-hitting determination, such as was young Perkin's, and an opportunity to bring through the medium of glass added beauty to "the more colorful world" which Perkin unfolded.

It might be asked at this point: But glass is inorganic; it can be colored quite readily inorganically by the colloidal suspension of metals in its composition as it is being formed; why then resort to the use of organic dyestuffs on glass fibers? The answer is simple. Glass fibers *can* be colored by the internal application of colorants, just as is being done in the manufacture of some organic synthetic fibers today, but a single glass filament in a normal glass textile yarn is so fine (about 0.00020 inches) that a batch of glass pigmented to such a degree as to be nearly jet black in appearance is seen to be a very pale pastel shade when it is drawn out to this fine diameter. Add to this the fact that the metallic components needed for coloring complicate glass viscosities, furnace lives, and efficiencies to the point of making the cost of these pale yarns prohibitive. And then further consider that only a limited selection of colors could be possible and that, in the decorative fabrics field, where glass textiles are making their major inroads, a myriad of colors to fit the tastes of the consumers are needed. Then I think you will see the desirability of employing Sir William's type of colorants.

COLORING OF GLASS YARN ———This does not mean, however, that the coloring of glass textiles is confined merely to piece dyeing and printing. There is such a thing as a dyed glass yarn. Here the coloring is achieved by either of two methods: one, a standard package-dyeing technique; the other, the single-end bonding of a pigmented resin to a yarn.

The product of either of these two methods finds wide usage in the electrical wire industry as an identification or tracer yarn. These dyed yarns must have excellent resistance to such solvents as toluol, ethyl alcohol, ethylene glycol, carbon tetrachloride, boiling water, salt water and gasoline, and have fair crock resistance and excellent heat stability.

*Presented on September 13, 1956 during the Perkin Centennial celebration at the Waldorf Astoria, New York, NY.

PACKAGE DYEING ——— The package-dyeing technique is made possible by the fact that the yarns going into this operation are sized in their manufacture with an insolubilized protein. This protective protein film readily accepts most direct dyes as well as acid and milling types.

Yarns dyed by this technique are not suitable for use in the weaving of decorative glass fabrics, for in the finishing of such fabrics they would be subjected to a temperature of about 1200° F, which would completely burn off all organic matter and thus destroy the dye.

RESIN BONDING ——— In the resin-bonded approach to pigmenting glass yarns, the coating comprises only a small fraction of the overall weight of the yarn—somewhere in the neighborhood of five percent. During the last year or two we have witnessed the growth of a new type of pigmented glass yarn, one whose coating comprises about fifty percent of its weight. It is much more functional than the electrical tracer yarn and much more decorative. I speak now of vinyl-coated glass yarns. These yarns possess not only the great tensile strength, chemical resistance and dimensional stability that is inherent in glass, but the engineering of the vinyl coating and its application has been such that heat and flame resistance, corrosion resistance, resistance to weathering, superlative lightfastness of colors, low temperature flexibility, good weaving properties, beauty of appearance and low cost have all been achieved.

One of the first obviously commercial applications for a yarn possessing such a vast array of properties was insect screening. Here it has already become established as major competition for metal screening. This trend away from the drab, staid metallic greys to brighter, more pleasant colors is certainly making an important contribution to "the more colorful world" of Perkin. One other factor worth considering here is that this fibrous-glass insect screening is bringing a new area of business to textile weavers, for this screening is being woven on conventional textile looms by textile people.

In the coating operation, continuous filament glass yarns are pulled through a bath of polyvinylchloride plastisol or organisol, then through a wiping die and continuously on through an oven, the temperature of which is high enough to heat the coating to its fusion temperature of about 350° F. Several coatings can be superimposed over one another, and indeed some very unique and desirable decorative effects have been achieved by overcoating a pigmented layer with one or several clear layers.

Its dimensional stability, resistance to soiling and, hence, its ability to look "ever-new," as well as its sparkling interplay of translucency and opaque color instantly attracted the high fashion shoe trade to fabrics woven of this yarn.

Yarns of this same type are being evaluated in hats, belts, aprons, handbags and as effect yarns in many fashion items . . . outdoor upholstery, awnings, automotive seat covers and upholstery. Luggage fabrics is another area into which this new basic textile is carrying the concept of "the more colorful world" we are honoring here today.

I mentioned the "ever-new look" that certain inherent properties of glass, such as dimensional stability and resistance to attack from organisms and the elements, bring to fabrics woven of vinyl-coated glass yarns. In the field of decorative fabrics, curtains and draperies where bare glass yarns are used, this "ever-new" property is even more in evidence and has brought to the decorative fabric trade a new concept of beauty with function. Fabrics no longer need be omitted from certain types of functional modern decor because they collect dust or cut off too much light or shrink or sag or fade in sunlight, or are a fire hazard, or are otherwise costly to maintain. Fabrics of fibrous glass have clearly shown that it is possible to achieve the functionalism with beauty that today's progressive consumer demands, and thus have helped to stave off the inroads that certain types of nontextile decor had begun to make upon the woven fabric industry.

FINISHING AND DYEING OF GLASS FABRICS———Now, just how does one go about achieving these desirable characteristics in a glass fabric? Let's begin with our wrinkle recoverability property, which is better known in the trade as the "wash and hang" story. Organic fiber producers may set this as a goal, but its achievement by them must of necessity be a difficult if not an impossible one. A glass filament, you see, under conditions of normal usage has no yield point. This means that once it is heat-set, its weave is set permanently. It then has a permanent shape, a permanent wrinkle-proofness, a real "wash and hang" property. This characteristic is not one that was developed. It is innate in glass.

Now let us look further into the finishing and dyeing of glass fabrics. Figure 1 is a schematic drawing of a Coronizing unit. Here we see that the glass greige goods are fed into a "muffle" or weave-cut oven, which is maintained at a temperature of 1200° F, to which temperature they are subjected for a period of from two to twenty seconds, dependent on speeds and weight of fabric.

Just what happens in this muffle? First, all organic matter which the greige goods might contain in the form of yarn sizings or lubricants is instantly burned off, leaving a pure, clean, bare glass fabric. Secondly, a permanent crimp is set in the fibers at this point that conforms to the weave pattern of the fabric. It may also be noted that the glass filaments are now much softer, limp and relaxed. If the fabric were to be removed at this point, we would find that it draped well and that all wrinkling would be almost instantly recoverable. Here we have bare glass with no yield point and with all its perfect elasticity.

The next section of the schematic drawing of the Coronizing unit shows a conventional dye pad. This performs a two-fold operation. A protective finish is applied simultaneously with colorants. This finish must not only furnish abrasion resistance to the glass fabric, but must be capable of bonding the pigments used as colorants to the fabric.

A permanent bond of resin-pigment to fabric is not achieved until the fabric is dried and cured in this next cure box and then padded again with a chrome complex and re-cured.

I think it should be almost obvious, at this point, that the success of dyeing and finishing a glass decorative fabric depends, for the most part, on the selection of the particular resin or combination of resins applied in the first padding operation. No organic material we might choose would equal glass itself in this property of wrinkle recoverability. We must be careful, then, that the only candidates considered for this finish are those that can do their protective and bonding job with a minimum effect on this property. The resins chosen should not detract from the fireproofness of the fabric, neither should they be of a type that soils too easily or does not shed soil readily. The sunlight resistance of the bare glass fabric is paramount. I doubt if any resin or organic pigment known today could match it. But whatever resins or pigments are chosen to go into this first pad box, they must come as close as is organically possible to this ultimate to qualify.

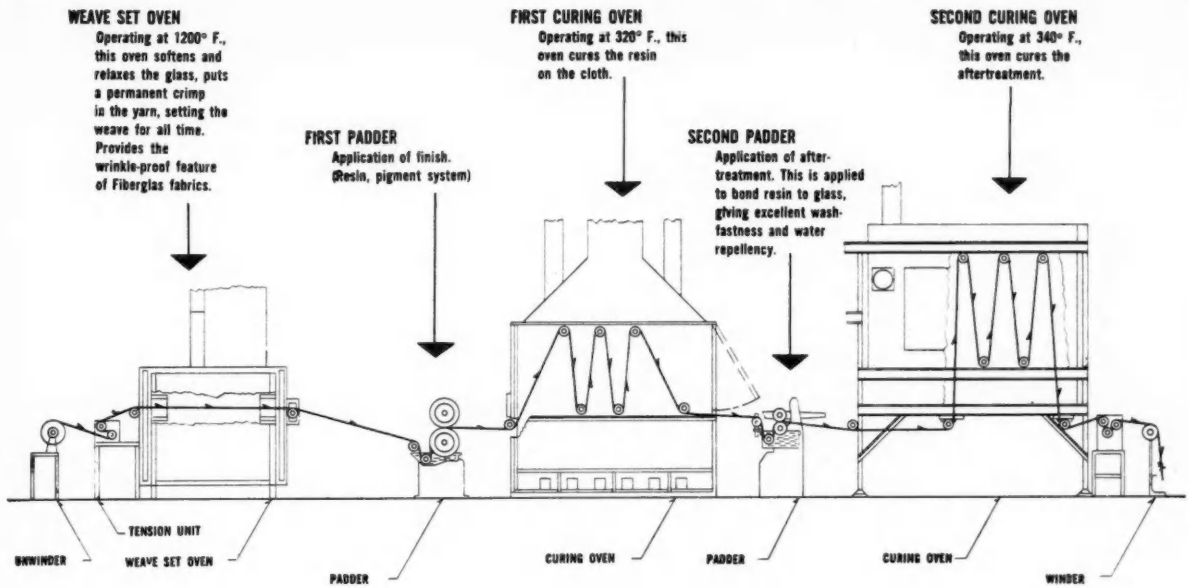

WEAVE SET OVEN
Operating at 1200° F., this oven softens and relaxes the glass, puts a permanent crimp in the yarn, setting the weave for all time. Provides the wrinkle-proof feature of Fiberglas fabrics.
FIRST PADDER
Application of finish. (Resin, pigment system)
FIRST CURING OVEN
Operating at 320° F., this oven cures the resin on the cloth.
SECOND PADDER
Application of after-treatment. This is applied to bond resin to glass, giving excellent wash-fastness and water repellency.
SECOND CURING OVEN
Operating at 340° F., this oven cures the aftertreatment.
UNWINDER
TENSION UNIT
WEAVE SET OVEN
PADDER
CURING OVEN
PADDER
CURING OVEN
WINDER

Figure 1
A schematic drawing of the Coronizing operation for finishing Fiberglas fabrics, showing the basic operations performed.

The finishes which are doing the best job on glass draperies and curtains today are all based on plasticized vinyl resin derivatives. They help glass fabrics attain excellent washfastness, lightfastnesses (and I include here rigid alternate light exposure and washfastness testing) that can be rated with the best in the trade, soil resistance, rapid soil release that cuts washing time to less than five minutes in most instances, desirable hand and drape, water repellency, and a true no-ironing story.

Figures 2, 3 and 4 illustrate what a poor choice of bonding resin could do. The comparison is made with one of the current finishes being used today. In Figure 2, two light-exposure cards are shown of two fabrics finished in precisely the same fashion with the same pigments; but with the one labeled X, an unsuitable resin was employed, while with the other, one of the approved resins was used. You will note that the standard shows no change in shade after two fifty-hour exposures to ultra-violet; each followed by a hand wash. Resin X, however, does not do as well, its power to bond the pigment to the glass having been lost before even the fifty-hour exposure mark.

Figure 3 compares the soil-releasing properties of the standard resin with that of an unsuitable resin. Both specimens were tumbled for the same length of time in an oily soot and then hand washed. The difference in appearance needs no explanation.

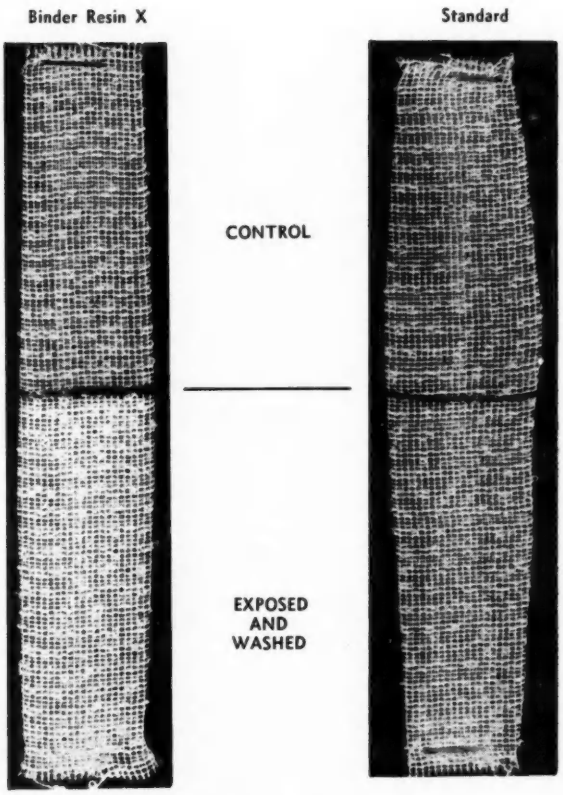


Figure 2

Comparative fastness to washing after exposure to UV light. Samples exposed 50 hours to UV, washed 5 minutes, re-exposed 50 hours and rewashed.

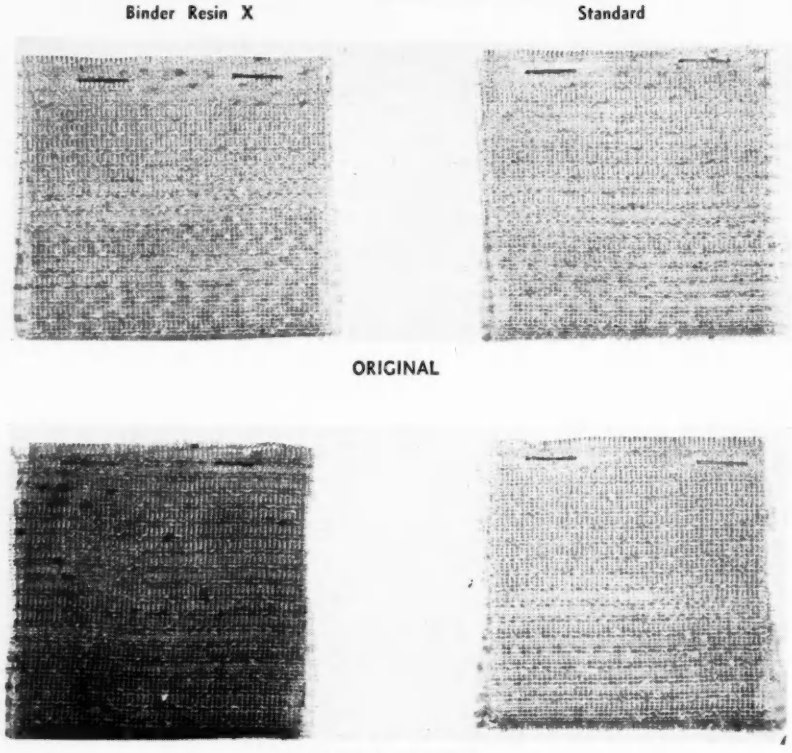


Figure 3
Comparative soil-releasing properties

Figure 4 shows how a poor choice of resin influences the abrasion resistance of a fabric. Both specimens shown were run in an AATCC Accelerotor at 2000 rpm for five minutes. You will note that the hems of standard fabric are unaffected by this treatment, but that the specimen finished with resin X failed very miserably at the hems.

Thus far we have touched upon only piece-dyed glass fabrics. The same Coronizing process is used to prepare the goods for printing and then the conventional methods of mechanical roller printing, surface or mechanical block printing and screen printing are applied to the fabric. Here again the choice of bonding resin, whether in the prepare for print or in the print pastes themselves, is very critical, and the same dangers that might occur from the improper choice of resin in piece dyeing can occur in printing with perhaps even more deleterious effects since the print resins are only on one face and on the surface.

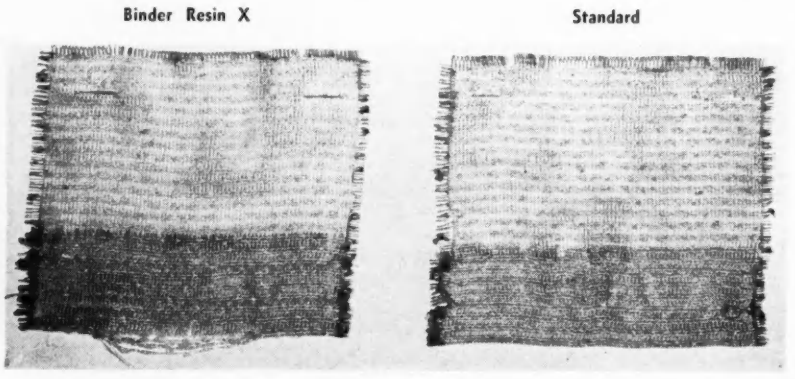


Figure 4
Accelerotor hem abrasion test at 2000 rpm for 5 minutes

I want to call attention for a moment to the fact that the last step in piece dyeing was the application of a fixing bath composed of stearato chromic chloride. In the preparation of fabrics for printing, it had been the procedure, up until very recently, to by-pass this water-repellent bath. The printer would then have to apply this fixing bath himself. Today, by use of an amine additive to the print paste itself, it is possible for roller printers to print over fabrics that have already received this water-repellent fixing treatment in the Coronizing process. This, of course, eliminates a subsequent finishing operation for the printer. This is true of roller printing and mechanical block printing only. We are currently working out the problems encountered in screen printing systems.

While on the subject of printed glass fabrics, I should like to point out another new dimension that colorants on glass textiles have brought to the drapery field. Glass fabrics have two inherent properties which lately have been getting a great deal of attention from forward-looking, creative designers. I am referring to the translucent property of glass and to its high reflectivity. When we couple these two properties with the opacity of the resin-pigment systems used in the printing of glass fabrics, an entirely new realm of decoration is opened up for the textile designer.

I think you will agree with me that certainly this is a new concept in the textile industry's approach to "a more colorful world", which is the keynote of this Perkin Centennial.

CONCLUSION

I should like to quote from a speech made by Dr R P Linstead, rector of the Imperial College, London, in opening the Perkin Memorial Exhibition:

"If we wanted a monument to Perkin we should look around the factories of England today in which synthetic organic chemicals are made, because Perkin not only discovered the dye, but also the idea that we could make things synthetically on an industrial scale; that was quite a new idea. If we looked around the factories in which that idea was the kernel we should find the monument to Perkin's achievement."

Gentlemen, I would like to suggest that the textile industry in America today, in all its phases, is another colorful memorial to a great inventor and a great man, Sir William Perkin.

Perkin Centennial———

A CENTURY OF PROGRESS IN THE DEVELOPMENT OF COLORFASTNESS TEST METHODS FOR TEXTILES*

M L STAPLES

Ontario Research Foundation, Toronto, Canada

In the course of manufacture and in subsequent use, dyed textiles are required to withstand the action of many different agencies. This has resulted in the need for methods of test which can be employed to assess the suitability of dyestuffs for specific applications.

The colorfastness of dyeings has been considered to be important from earliest times. When comparatively few natural dyes were available, control of quality standards was exercised by various guilds or by the state. The discovery of synthetic dyes focussed increased attention on colorfastness, and today a concerted effort is being made to develop test methods which are acceptable internationally.

This paper traces the history of colorfastness testing and refers particularly to progress since the time of Sir William Perkin. It records the contributions made by dyestuff manufacturers and by the organizations such as the Deutsche Echtheitskommission, the Society of Dyers and Colourists and the American Association of Textile Chemists and Colorists. Reference is also made to work on the standardization of colorfastness test methods by Technical Committee 38 of the International Organization for Standardization.

The paper concludes with a brief discussion of some of the problems yet to be solved before colorfastness testing will answer fully the questions raised by the complicated needs of the present and immediate future.

INTRODUCTION

ON the occasion of the Perkin Centennial it seems appropriate to look back to the origin of methods for assessing the colorfastness of textiles and to consider the progress that has been made since the first tests were recorded. The history of the subject is to be found in numerous papers, reports and books that scientific investigators and societies have published over the years. While a few articles have been written on the history of certain test methods (*33, 35, 43, 94, 95, 101, 129, 130*), it appears that no attempt has been made to give a general account of the subject. The purpose of this paper, therefore, is to review the important contributions that have led to the development of colorfastness tests as they are known today. Emphasis will be placed on the history of the subject.

EARLY HISTORY

Before the time of Sir William Perkin, the only coloring matters known were naturally occurring, and these were derived almost entirely from plants, insects and shellfish. Since the range of dyes available was extremely limited, it is reasonable to suppose that their fastness properties would soon be determined by experience. There is no doubt that the importance of the colorfastness of dyes was recognized at least as early as the first century, for a remarkable reference to the quality of colors was given by Plutarch in his "Life of Alexander" (*26, 121*). He wrote that Alexander found among the treasures in the palace of the King of Persia, a large quantity of purple dyed material which, although 190 years old, had retained its "beautiful brilliancy." This would suggest that the distinction between fast and fugitive colors was appreciated even in ancient times.

Pliny, almost nineteen centuries ago, described the Egyptians as practicing a type of dyeing that "could not be afterwards discharged by washing" (*19*). This was one of the earliest references to the importance of fastness to laundering. It is claimed that in France in the thirteenth century, "the knowledge of dyes and their fastness was already considerable" (*125*). A letter written by William Cole (*39*), which discussed the effect of sunlight and laundering on dyed fabrics, appeared in the *Philosophical Transactions* as early as 1685. Cole described how a viscous white substance obtained from a species of shellfish, when painted on linen, "will presently appear of a pleasant green colour and if placed in the sun it will change to a deep green, and in a few minutes this will alter to a blue; from that in a little time more it will be a purplish red, after which in an hour or two (supposing the sun still shining) it will be a very deep purple red, beyond which the sun can do no more." Finally he stated that "the last and most beautiful colour, after washing in scalding water and soap and placed in the sun to dry, will be a fair bright crimson which will continue the same in handkerchiefs that have been washed more than forty times."

Early interest in colorfastness is indicated by the fact that the quality of a dyer's work was controlled by guilds, not unlike trade unions, which existed in England and on the Continent at least as early as the 12th century. The history of countries in Europe during the Middle Ages contains references to regulations guaranteeing the durability of dyed fabrics, for it is stated that the finished cloth was subjected to a final test at the hands of masters appointed by the guild, before it was sold (*84*).

In most countries, dyers were divided into at least two groups, the dyers of fast colors and the dyers of fugitive colors (French "Grand teint," and "Petit teint"). This distinction also reflects an early appreciation of differences in the quality of dyeings. Until the 18th century the "Grand teint" or fast dyes were woad, kermes and madder. The "Petit teint" or less durable dyes were mainly vegetable extracts. Rigid control was exercised by the guilds, and dyers of one group were not allowed to apply or even possess dyes that belonged to the other group.

Although no mention is made of colorfastness testing, the kinds of dyes and the way fabrics could be dyed were subject to compulsory supervision by the guilds. For example, in the year 1301, the Cloth Merchants' Guild in Florence proclaimed that materials not dyed according to regulations were to be burned, and both the dyer and the person who ordered the cloth would be fined. If the dyer, who was generally a poor man, could not pay the fine, he was to suffer the loss of one of his hands, rather rigorous treatment to ensure that standards were met!

An important advance in improving colorfastness standards was made in the 17th century when Colbert reorganized the textile industry of France and the state became responsible for guaranteeing the quality of

*Presented on "International Day," September 10, 1956 during The Perkin Centennial celebration at the Waldorf Astoria, New York, N Y.

the goods. An ordinance which was issued to the dyers of France, specified the dyestuffs to use and the methods by which they should be applied to obtain the best colorfastness known at the time. Early in the 18th century a system for the classification of dyes was developed by Charles Dufay (*126*). According to his scheme, a dyed fabric was boiled in alum, soap, and tartar, and the effect of these treatments was taken to indicate the fastness of the dye and the category in which it had been dyed. Furthermore, Dufay also described a rather crude test to determine the influence of light on dyed fabrics by exposing them for 12 days in the summer and 18 days in the winter. It was claimed that this was a decisive test; fast colors were unchanged or nearly so, while fugitive colors were almost completely bleached. To allow for differences in light intensity from one season to another, Dufay selected one of his most fugitive colors and used it as a standard (*68*).

Extensive investigations on the effect of such agencies as light, soap liquors, chlorine bleaches, acids and alkalies were carried out by Edward Bancroft and are recorded in a book which he published in 1814. Bancroft concluded that "the durability of a color must depend not only on the natural stability of the coloring matter but also upon the energy of its affinities, both for the stuff which is dyed and for the basis or intermedium (mordant) upon which it is immediately applied and which by its own peculiar attractions, binds them to each other" (*19*).

The influence of the fiber substrate on colorfastness was mentioned by Bancroft and seems to have been generally recognized by the end of the 19th century. According to a statement by Gibson which appeared in 1873, "Every dyer knows why the same colours put upon cotton will not resist the action of those agencies that remove them, as well as the same colour will when placed upon wool" (*58*).

In the "Dictionary of Arts, Manufactures and Mines," published in 1867, Ure described, in general terms, the tests which were used at that time. He said that "In trying the stability of dyes, we may offer the following rules: Every stuff should be exposed to light and air; if it is intended to be worn abroad, it should be exposed also to the wind and rain; . . . and cloths to be washed should be exposed to the action of hot water and soap. However, such tests are not at all applicable to most of the colours dyed upon cotton stuff. Not many of them can stand the action of hot water and soap, or even such acids as the juices of fruits. Indigo blue, one of the most permanent dyes on cotton, yields its intensity to every operation of washing, even in pure water" (*122*).

DEVELOPMENT OF SYNTHETIC DYES

Although the art of dyeing textiles has been known for many centuries, it was not until the discovery of synthetic dyes that attention was focused on the importance of colorfastness testing. It is recorded that a silk dyer named Thomas Keith exposed to light specimens which had been dyed with Perkin's new mauve, and the results were such that he encouraged Perkin to proceed with the production of the dye. Only after passing this lightfastness test was manufacture of the dye actually started. Perkin has emphasized what was at that time regarded as the high lightfastness of his mauve dye compared with other synthetic colors, but by present standards the first coal tar dyes, although extremely bright in shade, were of poor fastness.

When faster dyestuffs became available toward the end of the last century, the commercial importance of colorfastness was finally realized and methods for its assessment began to appear. At first, tests were developed by dyestuff manufacturers, who as a group were reticent about disclosing information on this subject. It was not long, however, before dyestuff companies began to issue books and pattern cards describing their products and giving instructions on their application. These publications contained tables which listed the colorfastness of each dye to various agencies and outlined the methods by which fastness had been determined. It is interesting to peruse some of these early publications. A book, printed in 1898, entitled "Die Wollfaerberei unter Anwendung der Farbstoffe der Farbenfabriken vorm Friedr Bayer & Co, Elberfeld," gave procedures for determining fastness to milling, acids, alkalies, carbonizing and stoving.

In contrast to this, another publication, issued in 1906 by the same company and dealing with Benzidine Dyes, gives no precise information on colorfastness testing.

One of the first systematic treatments of the subject appeared in a comprehensive treatise entitled, "A Manual of Dyeing," by Knecht, Rawson and Loewenthal, which was published in 1893. These authors outlined tests for colorfastness to five different agencies—light, washing, acids, stoving and hypochlorite bleaching. Reference is also made to fastness to rubbing, hot pressing, sublimation and perspiration, but methods of test are not given (*78*).

In the same year, Adolf Lehne, in his "Tabellarische Uebersicht der küntslichen organischen Farbstoffe," gives directions for determining colorfastness to milling, decatizing, acids, rain, road dirt, bleaching, perspiration, rubbing, ironing and to washing of cotton or wool. The procedure recommended for assessing fastness to light was to fasten the dyed pattern on cardboard or wooden boards, cover one half, and expose it to "atmospheric agencies," that is, to weathering. Exposing materials under glass was not considered to be as satisfactory. Colorfastness was graded in terms of arbitrary standards.

An interesting book on the properties and application of the dyestuffs which were sold by the Berlin Aniline Company was published in 1904 (*118*). The book does not contain descriptions of actual test methods, but it does reflect a rather remarkable appreciation of the problems involved in colorfastness testing and the precautions that should be taken in interpreting test results. For example, it calls attention to the fact that the term "fastness" is subject to the most varied interpretations and the fastness of a dyeing should only be judged in relation to the manner in which it is to be used. It is pointed out that fastness depends not only upon the dyestuff but also on the type of fiber and on the method of application.

In speaking of lightfastness, the book cautions against comparing dyeings after a longer exposure than is needed for practical requirements. On the other hand, it states that the observer should not be misled by a rapid though insignificant change in shade, for afterward, the dyeing may resist the action of light for a very long time. It is further noted that before dyeings are compared, they should be exactly the same depth of shade and should be dyed on the same material. Finally the book remarks that "absolutely fast dyes do not exist; sunshine and rain finally bleach them all."

In 1911, a detailed account of test procedures and the use of numbers to rate colorfastness was published in a "Pocket Manual for Dyers" (*97*). The results of all tests (including fastness to light) were expressed by numbers from 1 to 5 in the order of decreasing fastness. Each number was defined in terms of the way in which

the dyeing behaved when subjected to specified test procedures. This scale for grading colorfastness is in the reverse order to the one now used.

In Lunge's "Technical Methods of Chemical Analysis" which was also issued in 1911, methods are given for testing the fastness of dyed yarns or loose fibers to ten different agencies (*87*). Many of the tests are similar to those which appeared in other publications of about the same time.

A historical review of the subject would not be complete without reference to the pioneering work of James Morton of Morton Sundour Fabrics, which began in 1903. This company was perhaps the first to demonstrate to the consumer that fabrics could be dyed with a high degree of fastness to light and washing. Although Morton's graphic account (*91*) of the obstacles that had to be overcome to produce a range of shades which could be guaranteed against fading by sunlight or washing does not describe the actual test methods used, nevertheless this development emphasized the importance of testing and stimulated the production of faster dyestuffs.

WORK OF THE SOCIETIES

From 1870 until the early part of the present century, the number of synthetic dyestuffs increased considerably. Since each dyestuff manufacturer used his own methods of testing and his own standards of grading (*53*), the same dyestuff often received different fastness ratings depending upon who sold it and how it had been tested.

The first serious attempt to eliminate some of the confusion and to establish standard methods of testing was made when a Committee was appointed in 1911 by the Section for the Chemistry of Dyeing and Textile Industries of the Society of German Chemists (DEK). At a meeting held in Karlsruhe in September 1911, this Committee, which perhaps was better known as the "Echtheitskommission," decided that for classifying the fastness of dyestuffs applied to textiles, five standards or grades should be adopted; one representing the lowest and five the highest degress of fastness to each agency. Later the DEK decided to increase from five to eight the number of grades used in rating colorfastness to light.

The first report (*56*) of the Echtheitskommission was published in 1914. This report described tests which were applicable primarily to cotton and wool and it included methods for determining the fastness to nineteen different agencies. Revisions which extended these methods to include all types of fibers and the addition of new methods were contained in subsequent reports, which were issued at irregular intervals. The third report was published in 1926, the sixth in 1932, the seventh in 1936 and the eighth report appeared in 1939. According to Schaeffer (*103*), the methods proposed by the DEK were not at first readily accepted by the industry in Germany but were in general use by about 1924.

The American Association of Textile Chemists and Colorists (AATCC) began work on the development of methods for determining the colorfastness of textiles in 1922 when the Research Committee held its first meeting. At that time it was decided that progress could best be made by appointing separate subcommittees to deal with each type of fastness, and the first Subcommittee on Fastness to Washing of cotton material was set up in 1922. The appointment of other groups on fastness to washing of silk and wool, fastness to light, perspiration, hot pressing, rubbing, boiling, steaming, decatizing, acids and alkalies soon followed, and by 1929 work was underway on methods for assessing the resistance to sixteen different color-destroying agencies.

Test methods are published annually by the AATCC in its *Technical Manual and Year Book*, whenever sufficient progress has been made by subcommittees to warrant such action. The first AATCC test method, a test for fastness to chlorine, was published in 1923. By 1954 the AATCC had published thirty-nine colorfastness tests (*7*).

Certain of the AATCC methods were proposed for materials which contained specific types of fiber; other tests were applicable to textiles made from any fiber. In some methods the fastness was rated in terms of reference dyeings whereas in others a "pass-fail" system of grading was used. In a few methods, the use of controls was specified to ensure that the test had been carried out properly.

Early in 1927, the Society of Dyers and Colourists (SDC) appointed a special committee to investigate the standardization of tests for determining the fastness of dyestuffs on textiles. Experimental work was undertaken in 1928 and the factors involved in the assessment of colorfastness to light, washing and perspiration were studied. As a result of this work, recommended methods of test were given in the report of the Committee (*110*), which was published in 1934.

The Second Report of the SDC (*111*) appeared in 1948. Whereas the First Report had dealt only with colorfastness to light, washing and perspiration, the Second Report included tests for fastness to thirty-three different agencies and listed methods that could be applied to dyed wool, silk, acetate, natural and regenerated cellulosic materials. With the exception of colorfastness to light and washing, the fastness assessment was based on a scale of 1 to 5, the latter representing the highest degree of fastness. Lightfastness was rated in terms of eight standards and fastness to washing was graded according to the severity of the laundering test which the dyed material would withstand. The Committee expressed the opinion that dyed controls were not required for the other tests and recommended the use of a Grey Scale to assess the staining of white material. The Grey Scale consisted of five steps of greys of decreasing visual contrast.

The Third Report of the SDC (*115*) was published in June 1955. Many of the methods contained in this Report were similar to those that appeared in the Second Report, but had been revised where necessary to make them conform to the methods which had been approved or were being developed by Subcommittee 1 of Technical Committee 38 of the International Organization for Standardization. The following are the main differences between the tests described in the Second and Third Reports:

a) The methods were no longer written in terms of a specific type of fiber, but each test was applicable to all fibers which may be subjected to the agency in question.

b) With the exception of colorfastness to light, the results of all tests were assessed by comparison with two Grey Scales—one for assessing change in color and the other for assessing staining.

c) The number of colorfastness to washing tests had been increased from four to seven to cover a wider range of possible washing treatments, and they were now applicable to any fiber.

Although the methods of the DEK had been in use in the countries of Europe for many years, it was not until about 1946 that France officially became interested in colorfastness tests. In December 1947, a special Subcommittee on Color Fastness (*130*) was set up by the Institute Textile de France (ITF) and one of its main objectives was the development

of international standards.

In 1947, the investigation of colorfastness test methods was undertaken in Switzerland by the Schweizerischer Verband für die Materialprüfung der Technik, Kommission 25, Textilien (SVMT). A study was made of the existing methods of the AATCC, the DEK and the SDC, and those best suited to the needs of the SVMT were adopted (*117*). In the setting up of standard methods for Switzerland, emphasis was placed on tests which would be applicable as far as possible to all types of fibers rather than having separate tests for each kind of fiber. In some cases the methods were modified to effect a compromise between those of the AATCC, the DEK and the SDC in the hope that, by so doing, it might facilitate acceptance of the methods internationally (*101*).

DEVELOPMENT OF TEST METHOD

Colorfastness to light, washing and perspiration are perhaps the most essential fastness properties of dyed fabrics from the ultimate consumer's point of view. It is not surprising, therefore, that in the search for test methods, most work has been done on procedures for assessing resistance to these agencies. And the task is not an easy one! Fabrics may be exposed to light, washing and perspiration under such varied conditions that, often, a single test method will not satisfy all of the requirements. In view of the importance of these three properties, separate accounts will be given of the history of their development.

COLORFASTNESS TO LIGHT

Earliest records tell of lightfastness tests being made by outdoor exposure. Until about seventy-five years ago, dyeings thus exposed were simply compared with one another, and since few dyes possessed any appreciable degree of fastness, a method of testing was of limited interest. However, with the discovery of synthetic dyes, it was not long before dyestuffs of improved fastness became available and there was a greater need for a method of assessment.

In 1893 Knecht, Rawson and Loewenthal (*78*) published the following method:

> "Fastness to light is best tested with the colour dyed on a swatch of calico or flannel exposed to light under glass, facing the south if possible. Part of the pattern is covered with thick cardboard, to protect it from the action of the light. At the same time another colour of known fastness and dyed as nearly as possible the same depth of shade on similar material, should be exposed for comparison, or rather to get an idea of the relative intensity of the light. The colour should be compared with the unexposed part, say after the first one or two days' exposure, and if it has not faded appreciably it might be left out for a week, a fortnight, or a month. If it has stood a month's exposure in summer without any material alteration, it may be called fast."

Toward the end of the last century the idea of trying to assign a numerical value to the fading power of sunlight and the use of standards began to emerge. Actinometers of different kinds were used by Scheurer and Brylinski (*106*), by Dosne (*50*), Bechtel (*24*) and others (*32, 107*). In 1898 Herzfeld (*70*) recommended for this purpose the use of cotton dyed with Turkey red or indigo; other standards, such as Victoria Blue R or Eosine on filter paper (*80, 102*), or Victoria Blue B on silk (*109*), were also proposed. The standards were exposed along with the test specimen until the standard faded to a definite end-point. This constituted one unit of lightfastness. The faded standard was replaced with a fresh standard and the process repeated until fading was shown by the test specimen. Lightfastness was rated in terms of the number of standards which had faded by the time the test specimen faded.

Using this approach, the British Association, at the instigation of Professor Hummel, undertook an elaborate series of outdoor exposures. During the period 1892-1900 practically all of the then known dyes on wool and silk were tested for colorfastness to light (*120*). From the results of these tests, the colors were divided into the following five classes: very fugitive, fugitive, moderately fast, fast and very fast.

For various reasons the standards which had been used up to this time were not entirely satisfactory and further investigation was required to clarify the properties required in a lightfastness standard. Scheurer (*104*) in 1898 outlined the conditions that he considered a standard should meet. These were: a) the dyed fiber must be of constant composition and unaffected by light (he considered cotton to be the best), b) the standard color must dye without the use of a mordant as the latter affects the fastness, and c) the standard color must be moderately fast to light. Cady and Appel (*37*) stated that a satisfactory standard must a) show a different amount of fading for each period of exposure, the differences being clear-cut and easily distinguished, b) show approximately the same relative degree of fading when exposures are made without glass, continuously or intermittently to sunlight or to the carbon arc, and c) to be a well-known dye of definite composition, capable of application by a simple method which is easily duplicated, and the dyeing must not change in color when stored. Cunliffe (*46*) considered that a lightfastness standard should be as insensitive as possible to changes in temperature, humidity and the concentration of sulfur dioxide or other gaseous impurities that might be present in an industrial atmosphere.

The first formal attempt to establish standards for rating colorfastness to light was described in the Report of the DEK (*56*), which was published in 1914. Separate sets of standards consisting of eight dyeings each, were proposed for cotton and for wool. These standards were to be exposed outdoors simultaneously with the test pattern, either without protection or under glass.

In later editions of the Report of the DEK, changes were made in certain of the standards and new ones were introduced for other fibers, so that by 1930 the standards shown in Table I had been recommended (*57*). It will be noted that, at this time, eight standards were given for testing cotton, wool, acetate and weighted silk, whereas only five standards had been developed for viscose rayon and unweighted silk. It was intended that additions would be made later to bring the total number of standards to eight for all fibers.

Further investigation showed that there was no need to have such a multiplicity of standards, and when the sixth edition of the DEK's "Verfahren Normen und Typen" was published in 1932, it contained a single scale of blue dyed standards on wool. These were intended to be applicable to all types of textile fibers. Another revision appeared in 1939 in the eighth edition of the Report of the DEK. The changes that were made in the standards are shown in Table II.

In 1922, an AATCC Subcommittee on Light Fastness began experimental studies which were directed toward the establishment of a test method. Exposures were made on the standards which had been proposed by the DEK, those then in use in the United Kingdom, and on over a thousand other dyeings (*37*). From the results of this work, six dyestuffs were tentatively selected in 1931 for use as standards. After further trials to determine the

TABLE I

German Lightfastness Standards (1930)

Standard	Cotton	Wool	Silk (Weighted)
1	5.0% Chicago Blue 6B	3.0% Indigotine IA pdr	0.2% Victoria Blue R
2	0.8% Methylene Blue BG (mordant)	1.5% Ponceau RR	3.0% Brilliant Sky Blue 5G
3	1.0% Indoine Blue R pdr (mordant)	2.75% Amaranth	4.0% Thiazine Red R
4	20% Kryogene Blue 3R	4.5% Azo Acid Red B	4.0% Croceine Scarlet 3B
5	2.5% Sirius Red 4B	5.0% Acid Violet 4RN	5.0% Brilliant Croceine 3B
6	10% Hydron Blue G 20% paste	2.5% Diamine Fast Red F (chromed)	6.0% Sirius Red 4B
7	8.0% Sulfur Black T extra	4.0% Anthraquinone Green GXN	6.0% Sirius Orange 5G
8	2.5% Indanthrene Blue GC paste	Indigo in depth of shade of 2.4% Sulphon Cyanine GR ex or 7.0% Naphthol Green B	6.0% Sirius Yellow RT

Standard	Acetate	Silk (Unweighted)	Viscose Rayon
1	1.0% Methylene Blue BGX	0.5% Victoria Blue R	0.4% China Green cryst (mordant)
2	0.2% Cellitazol B (Dev ON)	2.0% Fast Red O	4.0% Diamine Rubine S
3	0.5% Cellitazol RB (Dev ON)	2.0% Acid Alizarine Gray G	2.25% Brilliant Benzo Fast Violet BL
4	2.5% Cellit Fast Rubine B	2.0% Violamine ARR	1.5% Naphthol AS-RL, Fast Red RL Base
5	1.0% Celliton Scarlet B pdr	2.5% Indanthrene Brilliant Violet RR pdr	20% Indanthrene Blue GC
6	16% Celliton Fast Marine Blue B paste	—	—
7	3.0% Celliton Fast Violet ER	—	—
8	3.0% Cellit Fast Blue A	—	—

TABLE II

German Lightfastness Standards

Standard	1932	1939
1	0.6% Brilliant Wool Blue FFR extra	0.8% Brilliant Wool Blue FFR extra
2	0.6% Wool Blue N extra	1.0% Brilliant Wool Blue FFB extra
3	1.0% Brilliant Indocyanine 6B	1.2% Brilliant Indocyanine 6
4	1.5% Wool Fast Blue GL	1.2% Supramine Blue EG
5	1.3% Cyananthrol RX	1.0% Cyananthrol RX
6	2.5% Alizarine Direct Blue AGG	3.0% Alizarine Light Blue 4GL
7	2.5% Indigosol AZG	3.0% Indigosol O6B
8	3.0% Indigosol Blue AGG	3.0% Indigosol Blue AGG

TABLE III

American Lightfastness Standards

Standard	1931 and 1933	1937
1	2.0% Indigotine conc	0.8% Brilliant Wool Blue FFR extra
2	1.2% Scarlet 2R	1.0% Brilliant Wool Blue FFB extra
3	2.0% Amaranth extra conc	1.2% Brilliant Indocyanine 6B
4	1.8% Azo Acid Red B	1.5% Wool Fast Blue GC
5	2.5% Diamine Fast Red F	0.83% Cyananthrol RXO
6	6.0% Indigosol O	2.5% Alizarine Light Blue 4GL
7	—	3.5% Indigosol O6B
8	—	3.0% Indigosol Blue AGG

TABLE IV

Lightfastness Standards of the British Research Association for the Woollen and Worsted Industries (1925)

Standard	
0	Indigo Carmine X
1	Ponceau RG
2	Azo Rubine
3	Kiton Red S
4	Chlorazol Fast Red FG (chromed)
5	Indigo full shade or Naphthol Green B

best percentage of each dye, the tentative lightfastness standards shown in Table III were approved in 1933.

A year or so later, the first lightfastness standards of the British Society and the revised standards of the German Society were announced, and the AATCC decided to examine these standards together with those which it had recently adopted. As a result of this examination, a new series was selected in 1937 and it contained the blue dyeings which were believed to be the best of those available (see Table III). There was considered to be some difficulty in choosing eight wool dyes which possessed the required degrees of fastness, and at first only four of the eight (Nos. 1, 3, 5, and 8) were accepted as tentative standards (*4*). At that time, these standards were identical with those of the British and German Fastness Committees (*15*). During the next three years, the dyeings for standards Nos. 4 and 5 were changed to 1.1% Supramine Blue EG and 1.0% Anthraquinone Blue RXO (Cyananthrol RX), respectively, and minor changes were made in the depths of standards Nos. 6 and 7. The eight dyeings as thus revised were adopted as standards by the AATCC (*5*) in 1940.

The 1940 standards still left something to be desired, for their fading characteristics were not strictly in geometric progression. Since it was difficult to find single blue dyes for wool which would effect an improvement, the AATCC committee introduced, in 1943, a new approach to the development of lightfastness standards (*38*). Only two dyes were used, one a fugitive dye, Erio Chrome Azurole B (*CI* 720), and the other a very fast dye, Indigosol Blue AGG or Algosol Blue AGG. Wool slubbings dyed with each of these dyestuffs were blended in the proper proportions to obtain eight standards each having the required degree of fastness. It was claimed by the AATCC that spectrophotometric measurements have shown that the fading of the new standards, although not ideal, is more uniformly graduated than that of the older standards (*59*).

In 1925 Hirst (*71*), on behalf of the British Research Association for the Woollen and Worsted Industries, recommended a method of outdoor exposure for dyed wool, which was based on the use of only five standards. Another class—No. 0, was included for classifying dyes which cannot be considered to possess any degree of lightfastness. The standards which were proposed are given in Table IV.

The following year Crummett of the British Silk Research Association described a test for determining the colorfastness to light of dyed silk (*42*). His method was also based on the use of five standards.

After an extensive investigation, which was carried on from 1928 to 1932, the Fastness Committee of the SDC recommended a series of blue standards and a series of red standards on wool for assessing the lightfastness of all kinds of textiles. An attempt to include a set of green standards had to be abandoned due to the difficulty of finding suitable dyes. In the selecting of the standards, dyes were chosen which were not affected unduly by heat, moisture or atmospheric impurities. Tests had shown that dyeings on wool were less influenced by these agencies than those on cotton, linen or viscose rayon and therefore wool was chosen as the material to be used. As far as possible, the lightfastness of each standard in the series was intended to be twice as fast as the one preceding it. The standards proposed in the Report of the Committee (*110*), which was published in 1934, are listed in Table V. No Standard 1 was included. Any dyeing which was not as fast as Standard 2 was to be graded as Class 1.

It was recognized that certain of these standards were not entirely satisfactory and further research was directed toward improving them. It was believed also that some changes might result in a set of standards that could be accepted internationally, and therefore, a revised list of standards was published by the SDC (*8*) in 1940. These are shown in Table VI.

As a matter of record, reference might also be made to the lightfastness standards which have been adopted recently in France (*10*), Switzerland (*9*) and in the USSR (*98*). These standards, all of which are based on wool dyeings, are shown in Table VII.

The eight French and Swiss standards are dyed with single dyestuffs for each standard, whereas the five USSR standards are made with two dyes, dyeing first with Indigosol Blue AGG and then topping with Indigo Carmine in the proportions needed to produce the required degrees of fastness. The relationships between the fastness of French and Swiss standards and those of the USSR have not been given.

In the experimental studies which were carried out by the DEK, the AATCC and the SDC during the development of a lightfastness test method, outdoor exposures were made in a number of different ways—unprotected, under glass, continuously, intermittently, facing south, north, etc. As a result of this work, the DEK and the SDC recommended a "daylight" test in which the dyed patterns were exposed continuously under glass, facing south at an angle of 45°, although originally the test of the DEK called for exposure in a vertical position. On the other hand the AATCC preferred a "sunlight" test, in which the specimens were exposed under similiar conditions, except that exposure was made only between 9 am and 3 pm from April 1 to October 1, on days when the sun was not obscured by clouds. Tests had shown that more reproducible fading was obtained when exposures were made under the latter conditions (*36*). While the SDC considered that the "sunlight" test was very satisfactory, the "daylight" test was finally adopted for reasons of practicability (*110*).

Test racks for exposing specimens either under glass or without covering are shown in Fig 1. Fig 2 illustrates a standard AATCC metal cabinet with glass cover for lightfastness testing by the "daylight" or "sunlight" methods. Fig 3 shows several Epply pyrheliometers for measuring the intensity of solar radiation and Fig 4 illustrates the recorders to which they are connected. The chart on the left of Fig 4 is a record of the radiation measured behind glass, and the one on the right is a record of the direct radiation for the same period of exposure.

From about 1890 onward, the factors which affect the fading of dyed textiles was the subject of intensive study. It is outside the scope of the present paper to review in any detail the many publications that appeared in the literature during this period. However, brief reference will be made

TABLE V
British Lightfastness Standards (1934)

Standard	*Red Standards*	*Blue Standards*
2	0.5% Acid Magenta IIS	0.5% Lissamine Violet 6BNS
3	0.5% Polar Red 3B conc	0.6% Brilliant Indocyanine 6B
4	1.0% Cloth Fast Red R	1.1% Polar Blue G conc
5	1.0% Alizarine Rubinole GW	0.5% Solway Blue RS
6	1.0% Kiton Fast Red 4BL	2.0% Alizarine Light Blue 4GL
7	1.2% Alizarine Orange A425 pdr (on zinc)	4.0% Caledon Blue GCP 300 pdr
8	1.75% Durindone Red B400 pdr	3.0% Indigosol Blue AGG

TABLE VI
British Lightfastness Standards (1940)

Standard	
1	0.8% Brilliant Wool Blue FFR extra
2	1.0% Brilliant Wool Blue FFB extra
3	1.2% Brilliant Indocyanine 6B
4	1.1% Polar Blue G conc
5	0.8% Solway Blue RS (Cyananthrol RX)
6	2.5% Alizarine Light Blue 4GL
7	2.5% Soledon Blue 4BC powder
8	3.0% Indigosol Blue AGG

TABLE VII
Other Lightfastness Standards

Standard	*French (1949)*	*Swiss (1948)*
1	0.6% Brilliant Milling Blue BN	0.8% Brilliant Wool Blue FFR ex
2	0.8% Brilliant Acid Blue JR	1.0% Brilliant Wool Blue FFB ex
3	0.9% Brilliant Acid Blue 6B	1.2% Brilliant Cyanine 6B
4	1.75% Supracide Blue J	1.2% Supramine Blue EG *or* 1.1% Polar Blue G conc
5	1.5% Acid Alizarine Sapphire R	1.0% Alizarine Light Blue R
6	2.5% Acid Alizarine Sapphire 2JL	3.0% Alizarine Light Blue 4GL
7	1.0% Indigo 4B powder	3.0% Indigosol Blue 06B
8	3.0% Indigosol Blue AGG	3.0% Indigosol Blue AGG

Standard	*U S S R (1949)*
I	3.0% Indigo Carmine
II	0.7% Indigosol Blue AGG 2.2% Indigo Carmine
III	1.4% Indigosol Blue AGG 1.44% Indigo Carmine
IV	2.2% Indigosol Blue AGG 0.7% Indigo Carmine
V	3.0% Indigosol Blue AGG

Figure 1

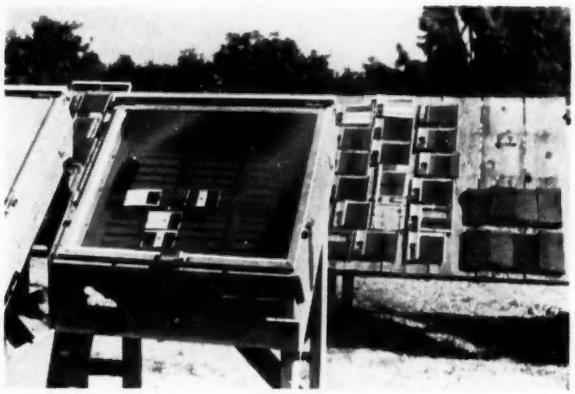


Figure 2

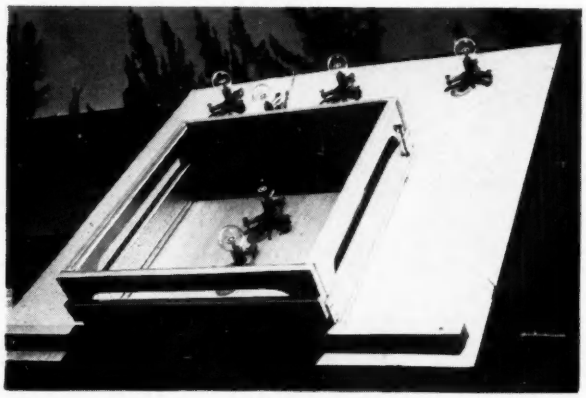


Figure 3

Figure 4

to a few, since the contributions which they made did much to elucidate the problems involved in lightfastness testing and pointed the way to future progress in the development of test methods.

Several research workers have found that certain factors, such as the quality and intensity of the light (*14, 17, 27, 32, 49, 54, 61, 66, 69, 73, 80, 83, 106*), the temperature and concentration of moisture in the atmosphere (*13, 32, 52, 60, 67, 73, 79, 83, 93, 105, 127*), the geographical location (*22, 36*), the depth of shade of the dyeing (*25, 64, 74*), the type of fiber substrate (*21, 55, 73*), the presence or absence of certain gases in the atmosphere (*32, 79, 93, 127*), the type of finish on the fiber (*31, 65, 77, 108*), and whether exposure was made under glass or without protection (*36, 80*), will all influence the rate of fading of certain dyes. It will be apparent, therefore, that the development of a satisfactory method of assessing colorfastness to light is not an easy matter. These and other factors must be considered before a standard method can be established in terms of exposure either to daylight or to artifical light.

While the "daylight" or "sunlight" tests were satisfactory in many ways, they are, nevertheless, subject to certain limitations. Perhaps the most serious from a commercial point of view is the fact that they are slow, particularly during the winter months. Furthermore, the intensity and spectral distribution of solar radiation varies with geographical location and from time to time during the day (*22, 41*). These objections were recognized early in the work of the societies and attempts were made to find an accelerated method which would be independent of the sun. During the period 1928 to 1932, the Fastness Committee of the SDC experimented with different types of fading lamps—the Fade-Ometer, the Fugitometer, and the fading apparatus of the Calico Printers' Association (CPA) (*44, 45*). In the Committee's report of 1934, the improved Fugitometer and the Humid Fading Lamp of the CPA were recommended as being equally suitable for accelerated fading tests (*110*).

The AATCC began its study of accelerated methods of testing in 1923 and concentrated its efforts on the various models of the Fade-Ometer (*34*). A method of testing based on the use of the Fade-Ometer was accepted by the AATCC seven years later (*2*), but the test did not become a tentative standard until 1937 (*4*). Attempts to improve the reproducibility of the Fade-Ometer (*128*), and to obtain consistent ratings from one

laboratory to another have been made (*96*), and to this end a calibration paper (*82*) has been developed. The use of this paper, specified in the AATCC method, makes it possible to express the rate of fading of any Fade-Ometer in terms of a standard lamp which is operated at the National Bureau of Standards in Washington, DC.

In the search for a rapid method of determining light fastness, various types of light sources, such as low and high intensity arcs, mercury vapor discharge lamps and tungsten filament lamps, have been investigated (*41, 51, 62, 63, 75, 86, 99*). The problem, however, has been to find a fading unit which has a) a spectral distribution similar to that of sunlight, b) an intensity of radiation high enough to provide an accelerated test, but not too high lest it produce abnormal fading, c) an adequate means of temperature and humidity control, and d) is practical to operate under ordinary laboratory conditions.

Up to the present time, no fading lamp has been developed which is acceptable internationally as the basis of an accelerated lightfastness test (*29, 100*) due chiefly to the inability of existing lamps to reproduce on all dyestuffs the same kind of fading that occurs during exposure to sunlight. In this connection, it is interesting to note that, according to Morton (*92*), "there is no such thing as a standard sunlight exposure to which an ideal fading lamp must conform, and it is well to conduct the argument for or against the use of fading lamps on this basis."

COLORFASTNESS TO WASHING

Although references to the importance of colorfastness to washing can be found in the early literature (*19, 20, 39*), it was not until late in the 19th century that instructions for testing were recorded in any detail. One of the first procedures was published in 1893 by Knecht, Rawson and Loewenthal (*78*). In this method, colored yarn was plaited with white yarn and worked for 15 minutes in a soap liquor at 140°F. The fastness was rated according to whether the dyed yarn had lost color or the white yarn had been stained. In 1898 Herzfeld (*70*) proposed a "mild" laundering test at 105°F and a "severe" test at 130°F, both for 20 minutes in a soap solution. Lange, in 1903, recommended two tests for cotton fabrics, one in a warm solution and the other at the boil for two hours. In both cases the wash liquor contained soap and soda ash (*81*). He also proposed separate tests for wool and silk fabrics. Throughout this period no reference was made to the use of standards to rate colorfastness to washing.

The First Report of the Deutsche Echtheitskommission (*56*) in 1914 provided separate tests for the fastness to washing of cotton and wool. A mild test and a more severe test were described for each type of fiber. Tests were carried out manually and colorfastness was assessed in terms of one or other of five grades (Grade I was the lowest) according to the change in shade or depth of the dyed pattern and the staining of adjacent white material. Dyestuffs were given (with procedures for their application) which were to be used to grade colorfastness.

In 1923 the AATCC first issued methods for testing the fastness to washing of dyed cotton, wool and silk textiles (*1*). Tests representing different degrees of severity were proposed for each type of fiber, and instructions were given for applying selected dyestuffs to obtain reference dyeings which could be used to determine whether or not the pattern passed a particular test. During the first few years, washing tests were carried out manually, and it was not until 1928 that the Launder-Ometer was introduced (*18*). Since then, mechanical agitation has replaced washing by hand.

From time to time changes were made by the AATCC in the reference standards by which fastness to washing was assessed, and new methods were added to provide tests for man-made and synthetic fibers. During the past ten years the AATCC has tried to eliminate unnecessary washfastness tests and to establish new tests which have a practical significance. In the current AATCC *Year Book*, an accelerated method of testing is given, which, it is claimed, will provide in one 45-minute test approximately the same result as that obtained in five average commercial or home launderings. In developing methods for fastness to washing and indeed in other tests as well, the AATCC has emphasized the need for methods which can be used to predict the way in which a dyed material is likely to behave under normal service conditions.

Four tests were proposed by the SDC (*110*) in 1934. The tests were intended primarily for cotton, but it was stated that they may be adapted to materials made from other fibers. They were designed to cover all degrees of severity from mild home washing to the cumulative action of several power launderings. Specimens were graded on a "pass or fail" basis in terms of reference standards. Two sets of five red and five blue standards on cotton were specified to facilitate the assessment. It was recommended that all tests be carried out in a mechanically driven wash wheel to avoid the inconsistent results frequently obtained by hand methods of agitation.

There were certain objections to the tests given in the First Report of the SDC's Fastness Test Committee. It was claimed that the methods did not adequately reflect washing conditions either by hand or in the laundry. Furthermore, corresponding red and blue standards did not always behave identically in the tests.

To overcome these and other objections, further experimental work was undertaken by the SDC, and this led to the publication of revisions of the methods in the Second Report of the Fastness Tests Committee (*111*). In this report, separate methods were given for wool, acetate, silk, cotton and other cellulosic fibers. Four tests of increasing severity were prescribed. Certain of the tests were intended to simulate either a single home laundering or a single commercial laundering, whereas other methods were designed to produce the results of repeated washings or laundering under more severe conditions. The use of reference standards had been abandoned and colorfastness to laundering was now assessed in terms of change in shade and/or loss in depth of the pattern, and staining of adjacent white material. Fixed standards or Grey Scales, which represented five grades, were used for this purpose. Grade 1 represented the lowest degree of fastness.

COLORFASTNESS TO PERSPIRATION

The first tests for colorfastness to perspiration were practical tests in which the dyed material was actually worn next to the body while the wearer was engaged in strenuous physical exercise (*81*). While it was realized that the alteration which dyeings undergo through contact with perspiration was due largely to the effect of weak organic acids, nevertheless there were other contributing factors, and until the latter part of the 19th century it was claimed that a reliable result could be obtained only by wearing the dyed goods (*118*).

Reference to the use of acetic acid solutions to determine the effect of perspiration has been made by a number of investigators (*70, 97*) beginning as early as 1898. On the other hand Davidis (*47*), in 1904, mentioned the

use of a soap solution containing ammonia as a test liquor.

In the first methods proposed by the Echtheitskommission (*56*), the colorfastness of cotton textiles was determined by treatment with a solution of ammonium acetate, whereas dyed wool was treated with a solution of sodium chloride. Further investigation led to revisions, and by 1939 one method was proposed for all types of fibers. In this method the dyed pattern was treated first for 30 minutes at 45°C with a solution containing sodium chloride and ammonia at pH 11.1, following which acetic acid was added to adjust the solution to pH 4.7 and the treatment was continued for another 30 minutes. Since 1939, the method of the DEK has been revised again, the alkaline solution being changed to contain sodium chloride and disodium phosphate adjusted to pH 9.5 with sodium hydroxide solution. The acid solution and method of treatment remained unchanged.

The AATCC (*3*) published its first method for assessing colorfastness to perspiration in 1925. This method made use of two separate solutions, one acid and the other alkaline, and both solutions were buffered with disodium orthophosphate. At first the test was carried out by rolling the treated specimens and placing them in tubes in a desiccator at room temperature. Later, desiccators were replaced by incubating the specimens at 100°F for periods ranging from 6 to 24 hours.

The uneven staining of adjacent white material, which was frequently obtained with the "tube" method, led to the substitution of a "plate" method for single samples or to the use of a mechanical device known as a Perspirometer for testing up to 30 specimens at one time.

The first AATCC method recognized only one classification of fastness; the pattern was either fast to perspiration or it was not. Criticism of this way of interpreting results led to the establishment of standards for indicating different degrees of fastness. This was accomplished with the introduction, in 1942, of four tests which differed only in the period of time the dyed pattern was allowed to remain in contact with white material.

The most exhaustive study of the factors to be considered in developing a test for fastness to perspiration was made by Vass and McSwiney (*124*) under the auspices of the Society of Dyers and Colourists. As a result of this work (*110*), a test based on the use of two solutions was proposed in 1934. The acid solution contained sodium chloride, urea and sufficient acetic acid to bring the pH to 5.6. The alkaline solution contained sodium chloride and ammonium chloride and was adjusted to pH 7.8 with acetic acid.

After further study, the SDC reached the conclusion that two different solutions were not necessary to determine fastness to perspiration, and in the Second Report of the Fastness Tests Committee (*111*) only one solution was prescribed. This was an alkaline solution that contained sodium chloride and was adjusted to pH 7.8 by the addition of sodium bicarbonate. Specimens were tested by a "plate" method at 37°C for four hours.

It was recognized, however, that none of the test methods that had been proposed up to this time would imitate the effect of natural perspiration on certain dyeings, particularly those in which copper was present. This led the SDC to set up a special subcommittee in 1948 to re-examine methods for testing the fastness to perspiration.

OTHER COLORFASTNESS TESTS

It is convenient to deal with the remaining thirty or so colorfastness tests as a group, for with a few exceptions, such as the fastness to rubbing, gas fumes, ironing, pressing, and spotting with water and solvents, all tests in this group are concerned mostly with resistance to the agencies encountered in mill processing. Reference has already been made to the fact that procedures for certain of the tests included in this group were first reported in the 19th century and additional methods were published early in the present century (*87, 97*).

The first report of the DEK, issued in 1914, contained procedures for determining the fastness to chlorine, acids, alkalies, water, sea water, acid boil, rubbing, stoving, carbonizing, scouring, mercerizing, peroxide bleaching, milling, potting, ironing and steam pressing, in addition to fastness to light, washing and perspiration. The methods were intended primarily for dyed cotton and wool, and colorfastness was graded with the aid of reference standard dyeings on a 1 to 5 scale in which 5 represented the highest degree of fastness. In later editions of the DEK's "Verfahren Normen und Typen", many of the first methods were revised and new methods were introduced to provide tests for other types of fibers.

The *1923 Technical Manual and Year Book of the AATCC* contains the first methods which this Association issued. It included, in addition to fastness to washing, methods of testing dyed silk or wool for fastness to scouring and fulling, and dyed cotton for fastness to fulling and chlorine. Fastness classifications were in terms of dyed cloth standards, and for most tests four grades of fastness were specified. The list of test methods was extended in the *1925 Year Book* to include fastness to dry and wet heat, acids, alkalies, and sea water, as well as to carbonizing. As mentioned earlier, a test for fastness to perspiration was also published in 1925.

The use of the Crockmeter to standardize the test for fastness to rubbing was first specified in the *AATCC Year Book* in 1935-6, and a scale of fixed standards for judging the results of rubbing tests (*4*) was first described in 1937.

In 1936, the AATCC methods for testing the colorfastness of dyed rayon first appeared and a method for determining the fastness of dyed acetate to gas fumes was adopted in 1940. Revisions and additions to the methods were made over the years, and by 1954 the AATCC had developed tests for assessing the fastness to thirty different agencies, not including colorfastness to light, laundering or perspiration (*7*).

It was not until the Second Report appeared in 1948 that the SDC published methods for testing the fastness of dyed textiles to agencies other than light, washing and perspiration. In this Report (*111*) methods were provided for materials made of natural or regenerated cellulose, wool, acetate, and silk. Change in shade or depth and staining were assessed separately on a scale of 1-5 in which grade 1 represented considerable change or staining; grade 3 slight, and grade 5 virtually none. Reference standards were not provided, but controls were given for the following tests on wool: fastness to carbonizing, chlorination, decatizing, peroxide bleaching and stoving. The use of a Grey Scale was recommended to facilitate assessment of the degree of staining.

ASSESSING THE RESULTS OF COLORFASTNESS TESTS

When a dyed textile material is subjected to a wetfastness test, there are usually two things that are of interest: a) the change in hue or depth of the pattern, and b) the staining of undyed material adjacent to the specimen during the tests. Until about forty years ago, colorfastness was rated by using descriptive terms

such as "excellent, very good, fairly good, moderate, sufficient and not good" (*118*). Scales of numbers, usually from 1 to 5, were also used, and this method was employed in the first edition of the *Colour Index* (*40*). However, both systems were subjective and lacked precision.

It was not until the First Report of the DEK appeared in 1914 that the use of standard dyeings was introduced, and the numbers used in grading became more meaningful (*56*). A reference standard was specified to indicate each of the major grades of colorfastness. Dyed standards to illustrate loss of color were also used in the washing tests recommended in 1934 by the SDC (*110*) and in the early test methods proposed by the AATCC (*1*).

It was realized that the use of dyed reference standards was not entirely satisfactory. Different dyeings were required for each test, and as the number of methods increased, the system became very complex. Alternative possibilities were sought, and the idea of fixed standards that could be used to assess the results of almost all colorfastness tests soon emerged.

In 1945, the US Quartermaster Corps recommended the use of the Munsell Grey Scale for rating colorfastness to rubbing (*123*). The AATCC considered this to be an advance but believed that the method of grading could be improved by using scales of five different hues in addition to the grey scale (*6, 72*). At about the same time, Imperial Chemical Industries Limited published scales of fixed standards in nine different hues, to illustrate five degrees of staining. Fixed standards were also given for assessing "change in shade" and "loss in depth" (*76*). In 1947, Geigy Co published sets of fixed standards which were similar to the ICI standards and which included scales in sixteen different hues (*119*).

Four years later, Davies and Marney (*48*) showed that, for all practical purposes, the same assessment of depth of staining could be obtained by using either the scales of nine hues proposed by Imperial Chemical Industries Ltd, or a single grey scale based on the one shown in the AATCC Chart for Measuring Transference of Color. This pointed the way toward the development of one grey scale for assessing staining, and the Society of Dyers and Colourists, in the Second Report of its Fastness Tests Committee (*111*), recommended its Grey Scale No. 1 for this purpose. The fact that a grey scale could also be used to grade the contrast between dyed patterns (*112*) was suggested in 1950. The principle of using fixed standards was soon accepted in Europe, and it was not long before other grey scales were developed in Switzerland, France and Germany (*12*). As might be expected, the scales differed. In some, the divisions of the scale were spaced at equal intervals, whereas in others the steps were in geometric progression. Intensive study was directed toward trying to decide which types of scale would best satisfy the requirements. The question was finally resolved at a meeting of Subcommittee 1 of Technical Committee 38 of the International Organization for Standardization (ISO) in New York in November 1952. Geometric scales for assessing staining and the effect on the dyed pattern were accepted as tentative international standards (*113, 114*).

An excellent detailed account of the development of the Geometric Grey Scales is given in a series of papers by McLaren (*88-90*).

DEVELOPMENT OF INTERNATIONAL STANDARDS

No account of the history of colorfastness test methods could properly be given without some reference to the development of international standards. The need for such methods was recognized many years before there was much progress, for it was not until the late 1930's that the first attempt at international standardization was made. Prior to this time, work on test methods was carried on more or less independently by technical committees principally in Germany, the United Kingdom and the United States. During the period 1937-1939, an effort was made by the American, British and German Committees to set up standards for assessing colorfastness to light which could be accepted by the three countries. Unfortunately, difficulties arose and war broke out before an agreement could be reached.

The next attempt to collaborate in the development of test methods was made in the late 1940's when four meetings were held by the Institute Textile de France and the Fastness Committee of the Schweizerischer Verband für die Materialprüfungen der Technik. The first joint meeting of the French, German and Swiss Fastness Committees was held in 1950, and in the following year most countries of Continental Europe agreed to form the ECE (Europaeisch-Continentale Echtheits - Convention or Groupement d'Etudes Continental-Europeen pour la Solidité des Teintures et Impressions) for the purpose of setting up colorfastness tests which could be accepted by the countries of Europe.

Throughout this period close cooperation had been maintained between the ECE, the SDC and the AATCC. An opportunity to meet to discuss methods of testing was provided by the ISO, which was formed in 1946. Subcommittee 1 of Technical Committee 38 was assigned the responsibility of developing international methods for determining the colorfastness of textiles. Membership is held through the official standards bodies of any country that is interested, and at the present time thirty-six countries are members of ISO/TC 38 and nineteen are members of Subcommittee 1.

Colorfastness testing was discussed in general terms at the first meeting of ISO/TC 38 in 1948 at Buxton, England. Subsequent meetings of Subcommittee 1 were held at Bournemouth in 1951, at New York in 1952, at Scarborough in 1954 and at New York in 1956. Detailed accounts of these meetings may be found elsewhere (*11, 16, 23, 28, 30, 85, 114, 116*). It is gratifying to note that international agreement has now been reached on over twenty different colorfastness test methods.

FUTURE OF COLORFASTNESS TESTING

Much has been accomplished during the last one hundred years, and the factors involved in developing test methods are far more clearly understood today than they were at the turn of the century. In this connection it is interesting to note the changes that have been made in the way in which data on the colorfastness of dyestuffs have been recorded over the past sixty years. Fig 5 illustrates a page from the "Dictionary of Coal Tar Colors," compiled by George H Hurst, 2nd Edition, published in 1896. Fig 6 shows a page from "Farbstoff Tabellen" by Gustav Schultz, 5th Edition, 1914. Fig 7 shows a page from the new *Colour Index*, 2nd Edition.

While a tremendous amount of progress has been made, it is apparent, however, that a good deal still remains to be done before colorfastness tests will answer fully the complicated needs of the present and the immediate future. This aspect of the subject will not be discussed in any detail, but it may be of interest to mention some of the problems that will have to be solved if test methods are to keep pace with the changing demands of the times.

sulphuric acid to a blue solution from which a violet precipitate falls down on diluting with water. Hydrochloric acid throws down a blue precipitate from the aqueous solution, while caustic soda throws down a maroon precipitate.—*Dyes* tannin mordanted cotton in bright blue shades of a reddish tone, turned dark blue by strong acids, fast to dilute acids; turned dark crimson by alkalies, fast to soaping.

Azophor Red PN—

(MEISTER, LUCIUS.)—A preparation of dinitro-para-nitro aniline in a stable form. —*Buff colored granular mass*, resembling crushed cork, almost completely soluble in water to a clear yellow solution.

Is used to produce a brilliant red (para-nitro-aniline red) on cotton prepared with beta-naphthol. (See Azo Coloring Matters, p. 36.)

Azophosphine—

(LEONHARDT.)—Nitrochrysoidine

$NO_2C_6H_3N : NC_6H_3NH_2NH_2$

Obtained by diazotising metanitraniline and combining with phenylene diamine. (1886.) *English patent*, No. 14,962, 1885. Not introduced in this country.

Azo Purpurine B—

(DURAND, HUGUENIN.)—(1894.)—*Red powder*, soluble in water to a turbid red solution, in alcohol to an orange scarlet solution, in strong sulphuric acid to a blue solution from which on diluting with water a black precipitate falls down. Hydrochloric acid throws down a black blue precipitate from the aqueous solution on which caustic soda has no action. —*Dyes* unmordanted cotton from alkaline or neutral soap baths bright orange scarlet shades, turned black by acids, and by alkalies, bleeds slightly on soaping.

Azo Purpurine 4B—

(DURAND, HUGUENIN.)—(1894.)—*Brick red powder*, soluble in water to a turbid red solution, in alcohol to a scarlet solution, in strong sulphuric acid to a violet blue solution from which on diluting with water a black blue precipitate falls down. Hydrochloric acid throws down a black blue precipitate, caustic soda throws down a scarlet precipitate from the aqueous solution. — *Dyes* unmordanted cotton from alkaline or neutral soap baths fine scarlet shades, turned deep blue by dilute acids, bright scarlet by alkalies, fast to soaping, not fast to light. *Dyes* wool from neutral baths bright scarlet shades, turned blue by acids, fast to alkalies and soaping, not fast to light.

Azo Purpurine 3R—

(DURAND, HUGUENIN.)—(1894.)—*Red powder*, slightly soluble in cold water, readily soluble in hot water to a scarlet solution, soluble in alcohol to an orange scarlet solution, in strong sulphuric acid to a blue solution from which on diluting with water a blackish blue precipitate falls down. Hydrochloric acid throws down a blackish blue precipitate from the aqueous solution, while caustic soda throws down a red precipitate.—*Dyes* unmordanted cotton and silk from alkaline or neutral soap baths, wool from neutral soap baths bright scarlet shades, fast to soap, turned blue by acids, red by alkalies.

Azo Red A—

(CASSELLA.)—Prepared from amido-azo-naphthalene and alpha-naphthol-di-sulphonic acid. (1891.)—*Dark red powder*, soluble in water to crimson solution, in alcohol to pale crimson solution, in acetic acid to crimson solution, in strong sulphuric acid to blue solution from which on diluting with water a violet precipitate falls down. Hydrochloric acid has no action on the aqueous solution; caustic soda turns it deep orange.—*Dyes* wool and silk from acid baths fine bluish crimson shades, turned bluer by acids, turned yellower by alkalies, not fast to soaping, moderately fast to light.

Azo Rubine A—

(CASSELLA.)—Syn. of Azorubin S.

Azorubin S—

(ACTIENGE-ELLSCHAFT.)—Sodium salt of naphthionic acid azo-α-naphthol mono-sulphonic acid

$C_{10}H_6SO_3NaN : NC_{10}H_5OHSO_3Na$

obtained by diazotising naphthionic acid and combining with α-naphthol mono-sulphonic acid N.W. (1883.) *English patent*, No. 2,296, 1883.—*Brown powder*, soluble in water to a crimson solution, in strong sulphuric acid to a violet solution, turning crimson on diluting with water. Addition of hydrochloric acid to the aqueous solution produces a brown gelatinous precipitate, while caustic soda turns the solution more scarlet.—*Dyes*, wool in acid baths a dark bluish red, very fast to acids, washing and light.

Figure 5

Handelsname und wissenschaftliche Bezeichnung.	Konstitution und Darstellung.	Literatur.	Eigenschaften und Verhalten. Anwendung und Nüance.
Azorubin [*AW*] [*Gr-E*] [*Lev*] **Azorubin A** [*C*] **Azorubine S** [*Sch*] **Azorubin S** [*A*] **Azorubin G extra konz.** [*M*] **Azosäurerubin** [*WDC*] [*CJ*] **Azosäurerubin R** [*K*] **Azofuchsine acide** [*R F*] **Echtrot C** [*B*] [*B K*] **Marsrot G** [*B*] **Carmoisin** [*S*] **Carmoisin B** [*By*] **Carmoisin S** [*H*] **Crimson** [*FA*] **Brilliant Crimson** [*Cl Co*] **Brillant-carmoisin O** [*M*] **Rouge rubis A** [*M Lv*] **Nacarat** [*P*]	Naphtionsäure → Naphtol-sulfosäure NW.	Erfinder: **Wis** 1883. D. P. 26012, 66838, 67240. E. P. 2237/83. Vergl. **Friedländer 1**, 901; **2**, 791, 793. **Heumann 3**, 42, 641. **Winther 1**, 801; **2**, 1264, 1348. **Schultz-Heumann 4**, 787, 985. **G. Schultz** (1. Aufl.) **2**, 98. Handb. (2. Aufl.) 804.	Braunes Pulver; **in Wasser**: mit fuchsinroter Farbe löslich. **Spektrum** in Wasser: λ 518,5. **Mit HCl**: dunkelroter Niederschlag. **Mit NaOH**: etwas heller. – **In konz. H_2SO_4**: violette Lösung. – **Mit H_2O**: fuchsinrot. **Färbt**: Wolle in saurem Bade (Methode b) rot. Beim Nachchromieren (Methode c) violettblau (Methode Cr). — Ausfärbung: Vergl. **Lehne 1**, No. 62; Farbenz. 1895, 96; **Bell. 23**; 1902, Bell. 24; Zeitsch. f. Farb.-Ind. 1904, Bell. – Chromotrop FB [*M*]: Egalisieren: 3—4; Verhalten gegen Baumwolle: 1—2; Verhalten gegen Seide: 1. **Echtheiten**: Reiben: 1—2; Licht: 2—3 Dekatur: 2; Karbonisieren: 1—2; Schwefeln: a) Änderung 1, b) Bluten 1. Wasser: 2—3; Waschen: 2; Soda (Entgerbung): a) Änderung 2, b) Bluten 2—3; Walken: a) Änderung 2—3, b) Bluten 2; Alkali: a) Soda 2—3, b) Ätzkalk 2.
Für nachchromierte Färbung: **Chromblau R** [*B*] **Chromotrop FB** [*M*] **Azochromblau R** [*K*] **Omegachromblau A** [*S*]			
Echtrot VR [*By*]	Naphtionsäure → 1 Naphtol 5-sulfosäure.	D. P. 66888, 67240 Vergl. **Friedländer 3**, 791, 793. **Heumann 3**, 641. **Winther 3**, 1348. **Schultz-Heumann 4**, 985.	Rotbrauner Pulver; **in Wasser**: mit blaustichig roter Farbe löslich. **In Alkali**: mit blaustichig roter Farbe löslich. **Mit HCl**: rotbrauner Niederschlag. **Mit NaOH**: keine Veränderung. **In konz. H_2SO_4**: rotblaue Lösung. **Mit H_2O**: rotbrauner Niederschlag. **Färbt**: Wolle in saurem Bade (Methode b) blaurot. Beim Nachchromieren: marineblau (Methode Cr). Ausfärbung: Vergl. Färbez. Bell. 19. Egalisieren: 3—4; Verhalten gegen Baumwolle: 1; Verhalten gegen Seide: 2. **Echtheiten**: Reiben: 1—2; Licht: 1—2 Dekatur: 2—3; Karbonisieren: 1—2; Schwefeln: a) Änderung 1, b) Bluten 1; Wasser: 1—2; Waschen: 2; Soda (Entgerbung): a) Änderung 2, b) Bluten 2—3; Walken: a) Änderung 2—3, b) Bluten 2—3; Alkali: a) Soda 2, b) Ätzkalk 2.
Für Nachchromieren: **Azochromblau B** [*K*] **Chromotrop F 4 B** [*M*] Zu dieser Klasse gehört auch: **Diamantblau 3 B** [*By*]			

Figure 6

With the introduction of spun-dyed or dope-dyed man-made fibers, it is now possible to manufacture colored materials whose lightfastness exceeds that of Standard 8. There is, therefore, a need to extend the scale of standards to be able to assess the fastness of colors of this type. If wool continues to be used as the fiber on which the standards are produced, there may be difficulties in the way of adding higher standards to the range.

On this side of the Atlantic particularly, there is a growing interest in the so-called "wash-'n-wear" fabrics. This is part of the trend toward the specification of consumer textiles in terms of end-use characteristics. What is required is a method, or perhaps the right combination of methods, which will come as close as possible to predicting consumer experience. In this connection reference may be made also to the development of accelerated methods of testing where the results obtained after one test are intended to simulate the effect of several treatments in service.

Certain properties of the new thermoplastic fibers make possible mill processes, such as heat-setting and high-temperature dyeing, that were not practiced with the older fibers. This, of course, introduces the need for colorfastness tests that were not previously required.

These few examples will serve to illustrate the fact that methods for colorfastness testing cannot remain static, but must continue to progress to meet the needs that will arise with the discovery of new fibers, new methods of processing and new end-uses for textiles.

ACKNOWLEDGEMENT

The author gratefully acknowledges the assistance of Dr P W Cunliffe, The British Cotton and Wool Dyers' Association, Limited; H P Ford, Ciba Co, Inc; J P Niederhauser, Compagnie Francaise des Matières Colorantes; Dr P Rabe, Farbenfabriken Bayer AG; and Dr H Ris, J R Geigy Soc An, who kindly suggested references to the technical literature during the preparation of this paper; and of C R Caryl, Desert Sunshine Exposure Tests; and E M DeNoon, South Florida Test Service for supplying illustrations. The author is particularly indebted to W D Appel of the US National Bureau of Standards, and to W H Cady, editor, *AATCC Year Book*, for their kindness in reviewing the manuscript and for helping in other ways.

C.I. 14720 Monoazo

C.I. Acid Red 14

APPLICATION DYEING

Wool Good exhaustion from a sulphuric acid and Glauber's salt dyebath

Levelling: S.D.C. Migration Test {Dyeing method III / Migration 3–4}

Silk Dyed from a formic or sulphuric acid and Glauber's salt dyebath

Nylon Dyed from an acetic or formic acid dyebath

Unions Wool and nylon dyed, silk stained, cellulose and acetate unstained

METHOD: Neutral ... ... □; Weak Acid ... ... ◪; Sulphuric Acid ... ■; Chrome in Dyebath □

PRINTING

Wool, Silk and Nylon For direct print styles

FASTNESS PROPERTIES etc

	A	B	C
Alkali	2		3
Carbonising	4	4	4–5
Chlorination			
Alteration		1	
Staining (Wool)		4–5	4
Staining (Cotton)		4	
Decatising	4–5	3–4	4–5
Light 1/3 Normal	2	2	3
Normal	3	3	3
2 Normal	6	4	4
Milling			
Alkaline			
Alteration		1	
Staining (Wool)	2–3	4	1–2
Staining (Cotton)		3	
Acid			
Alteration		3	
Staining (Wool)		2	4
Staining (Cotton)		3	

	A	B	C
Peroxide Bleaching			
Alteration		1	
Staining (Wool)	1–2	4–5	1
Staining (Cotton)		2	
Perspiration			
Alteration		3	
Staining (Wool)	1	2–3	2
Staining (Cotton)		3	
Potting			
Alteration		1	
Staining (Wool)		1	
Staining (Cotton)		4	
Sea Water			
Alteration		2	
Staining (Wool)	3–4	1	2–3
Staining (Cotton)		2	
Soaping			
Alteration		3–4	
Staining (Wool)	5	5	4–5
Staining (Cotton)		3	
Washing			
Alteration		2	
Staining (Wool)	3	5	3
Staining (Cotton)		4–5	

Dischargeability Good

Solubility Water, very good

Effect of Metals Copper, duller; Iron, much duller

TEXTILE USAGE DYEING

For yarns and piece goods as a basis for bright deep maroons and crimsons

On afterchroming a navy blue shade is obtained

Fastness Properties (C): Alkali 4–5, Carbonising 4, Decatising 4–5; Light 6, Milling (alkaline) 4, Peroxide bleaching 2, Perspiration 3, Potting 2, Sea water 4–5, Soaping 4–5, Washing 4

Generally on silk, the fastness to washing being lower than on wool. Used also as a fugitive tinting colour on silk

PRINTING

For direct print styles on wool, silk and nylon to give crimson and wine shades of very good colour value. An addition of resorcine to the printing paste is desirable

NON-TEXTILE USAGE

Lakes Of some interest for the preparation of heavy metal lakes

Leather On vegetable, chrome and semichrome tannages

Properties on Chrome Tannage (SDC): Light 2, Penetration 3

Occasionally used in finish colouring

Paper Occasionally used for colouring of crêpe tissues and surface colouring

Miscellaneous For dyeing anodised aluminium, in wood stains and inks and in purified form as a biological stain and for colouring of jams, canned goods, mineral waters and sugar confectionery

See Food Red T 102

Hue Bluish Red

Artificial Light: yellower

Acid Brilliant Rubine 2G	Acna
Acid Chrome Blue BA-CF	G
Acid Chrome Blue FBS	Gy
Acid Chrome Blue 2R	FDN
Acid Rubine	TSK
Amacid Carmoisine B	AAP
Amacid Chrome Blue R	AAP
Airedale Carmoisine	YDC
Azo Rubin (*Biological stain*)	NAC
Azo Rubine	FNC
	Ipcs, NAC, NCF
Azo Rubine AF	Ciba
Azo Rubine XX	CCC
Brasilan Azo Rubine 2NS	CDA
Brilliant Acid Rubine M	ICS
Brilliant Carmoisine	FDN
Calcocid Rubine XX	CCC
Carmoisine	Enia
	RL, S, YDC
Carmoisine BA-CF	G
Carmoisine GRN	W
Carmoisine LAS	JCO
Carmoisine 5	LBH
Carmoisine W	ICI
Chrome Fast Blue 2R	CAC
Chromotrope FB	FBy
Chromotrope FB	RL
Comacid Rubine R	NCC
Diadem Chrome Blue G, R	LBH
Edicol Carmoisine WN	ICI
Erio Rubine B	Gy
Ext. D&C Red No. 10	KO
Ext. D&C Red No. 10	NAC
Fenazo Red C	G
Hidacid Azo Rubine	HD
Hispacid Rubine F	RBM
Java Rubine N	Vond
Java Chromotrope FB	Vond
Kiton Crimson 2R	CAC
Kiton Rubine R	CAC
Kiton Rubine R	Ciba
Lighthouse Chrome Blue 2R	JCO
Nacarat	Fran
Omega Chrome Blue FB	S
Pontacyl Rubine R	DuP
Solar Rubine	NSK
Solochrome Blue FB	ICI
Tertracid Red CA	CT

C.I. 17930 Monoazo

C.I. Acid Red 15

APPLICATION DYEING

Wool Good exhaustion from a sulphuric acid and Glauber's salt dyebath

Levelling: good

METHOD: Neutral ... ... □; Weak Acid ... ... ◪; Sulphuric Acid ... ■

FASTNESS PROPERTIES etc

	A
Alkali	2
Carbonising	3–4
Light Normal	6
Milling	
Alkaline	4
Perspiration	3
Soaping	4
Washing	3–4

Hue Yellowish Red

Artificial Light: brighter

Eniacid Fast Scarlet G ... ... Enia

TEXTILE USAGE DYEING

Generally for yellowish reds of good fastness to light with moderate to good fastness to washing and milling. Suitable for yarns, piece goods and for loose wool and slubbing where subsequent milling is not severe

Figure 7

LITERATURE CITED

(1) *Technical Manual and Year Book of the American Association of Textile Chemists and Colorists* **1**, Howes Publishing Co, Inc, New York (1923).

(2) *Ibid* **VIII** (1930).

(3) *Ibid* **III** (1925).

(4) *Ibid* **XIV** (1937).

(5) *Ibid* **XVII** (1940).

(6) AATCC Subcommittee on Transference of Color, Report of, *Am Dyestuff Reptr* **34**, P166 (1945).

(7) *Technical Manual and Year Book of the American Association of Textile Chemists* and Colorists **XXX**, Howes Publishing Co, Inc, New York (1954).

(8) Anon, "Standard Method for Testing the Fastness to Light of Colored Textile Materials," *J Soc Dyers Col* **56**, 273 (1940).

(9) Anon, "Bestimmung der Lichtechtheit von Färbungen, Drucken und Farbstoffen," *Textil-Rundschau* **3**, 313 (Sept, 1948).

(10) Anon, "Normalisation des essais de solidité des teintures," *Teintex* **14**, 312 (July, 1949).

(11) Anon, "Colour Fastness Test Methods Developed," *Can Textile J* 69, 59 (Dec 5, 1952).

(12) Anon, "Richtlinien für die Bestimmung der Farbechtheit von Textilien," *Textil-Praxis* **7**, 157 (1952).

(13) Mid-West Section, AATCC, "A Study of the Effect of Temperature and Humidity on the Light Fastness of Synthetics in the Fade-Ometer," *Am Dyestuff Reptr* **43**, 497 (1954).

(14) Appel, "Fading of Dyeings in Radiation of Different Intensities," *ibid* **24**, 306 (1935).

(15) Appel, "The Use of Standard Dyeings in Tests for Color Fastness to Light," *ibid*, **27**, 15 (1938).

(16) Appel, "Tests for Colorfastness of Textiles under Consideration in the International Organization for Standarization," *ibid* **42**, 871 (1953).

(17) Appel and Smith, "The Fading of Dyed Textiles in the Light Transmitted by Various Glasses," *ibid* **17**, 410 (1928).

(18) Appel, Smith and Christison, "A Machine for Laboratory Washing Tests," *ibid* **17**, 3 (1928).

(19) Bancroft, "Experimental Researches Concerning the Philosophy of Permanent Colours", Vol I, p 256, Thomas Dobson, Philadelphia (1814).

(20) Bancroft, "Experimental Researches Concerning the Philosophy of Permanent Colours", Vol II, p57, 65, 165, Thomas Dobson, Philadelphia (1814).

(21) Bancroft, "Fastness of Dyes to Light", *Am Dyestuff Reptr* **12**, 935, 965 (1923).

(22) Barker, "The Standardization of the Fastness of Dyestuffs", *J Textile Inst* **18**, T 313 (1927).

(23) Bayley and Coke, "Standards Meeting at Bournemouth", *Can Textile J* **68**, 58 (Sept 14, 1951).

(24) Bechtel, "Use of the Prussiates of Iron in Measuring the Fastness of Dyes to Light", *Rev gén mat color* 13, 73 (1909).

(25) Berner, "Die Prüfung und Beurtheilung der Lichtechtheit von Farbstoffen" *Färber-Ztg* **4**, 3 (1892).

(26) Bischoff, "Versuche einer Geschichte der Färbekunst von ihren Entstehung an bis auf unsere Zeit", Stendal (1780). Referred to by Hübner, *J Soc Dyers Col* **29**, 344 (1913).

(27) Bolis, "Fastness of Dyestuffs to Light", *Rev gén mat color* **12**, 289 (1909).

(28) Bonnar, "Report on ISO Conference and Colour Index Meeting", *Am Dyestuff Reptr* **37**, 481 (1948).

(29) Boulton and Guthrie, "The Design of Fading Lamps", *J Soc Dyers Col* **67**, 190 (1951).

(30) "Bournemouth ISO Meeting on Fastness Testing", *ibid* **67**, 307 (1951).

(31) Brown, "Some Aspects of Dye Testing for Textile Application", *ibid* **53**, 87 (1937).

(32) Brownlie, "Remarks on the Chemical Action of Sunlight on Dyed Fabrics", *ibid* **26**, 191 (1910).

(33) Cady, "Summary of Progress in an Effort to Standardize Methods for Determining the Fastness of Dyes to Light", *Am Dyestuff Reptr* **11**, 382 (1922).

(34) Cady, "Report of Series 8 Light Exposures. A Comparison of the Fading Produced by Four Fading Lamps and the Sun on Forty Selected Dyeings", *ibid* **23**, 619 (1934).

(35) Cady, "The Historical Background of the New Standards for Light Fastness", *ibid* **33**, 29 (1944).

(36) AATCC Subcommittee on Light Fastness, Report, "1. Light Exposures, Series 3", *ibid* **16**, 707 (1927).

(37) AATCC Subcommittee on Light Fastness Report, "3. The Fading of Dyed Textiles in Daylight and in Carbon Arc Light", *ibid* **18**, 407 (1929).

(38) Christison, "New Proposed Standards for Light Fastness", *ibid* **32**, 511 (1943); *ibid* **33**, 33 (1944).

(39) Cole, "A Letter to the Philosophical Society of Oxford Containing William Cole's Observations on the Purple Fish", *Trans Royal Soc* **15**, 1278 (1685).

(40) Society of Dyers and Colourists, "Colour Index", Vol I, Bradford, Yorkshire, (1924).

(41) Cooper and Hawkins, "Spectral Characteristics of Light Sources for Fading and Degradation Testing", *J Soc Dyers Col* **65**, 586 (1949).

(42) Crummett, "Standardization of Methods of Testing the Fastness of Dyes", *ibid* **42**, 301 (1926).

(43) Cunliffe, "The Action of Light on Dyes Applied to Cotton Fabrics. A Summary of the Literature", *J Textile Inst* **15**, T 173 (1924).

(44) Cunliffe, "Preliminary Report on Investigation of the Fastness of Dyed Textiles to Light and Washing", *J Soc Dyers Col* **45**, 215 (1929).

(45) Cunliffe, "The Fading of Dyed Textiles", *ibid* **46**, 108 (1930).

(46) Cunliffe, "Standardizing the Methods of Testing the Fastness of Dyed Materials, Interim Reports of the SDC Fastness Test Committee", *ibid* **46**, 108 (1930); **47**, 7 (1931).

(47) Davidis, "Fastness to Perspiration of Dyed Goods", *Färber-Ztg* **15**, 373 (1904).

(48) Davies and Marney, "Fixed Standards for Staining Assessment in Fastness Testing", *J Soc Dyers Col* **67**, 438 (1951).

(49) Depierre and Clouet, "Comparative Action of Electric Light, Sunlight and Coloured Lights on Colours Printed on Calico", *Mitth des Tech Gewerbe-museums* **1**, No. 5 (1885); *J Soc Dyers Col* **1**, 245 (1885).

(50) Dosne, "Method of Determining and Expressing the Fastness of Colors to Light", *Bull soc ind Mulhouse* **70**, 207 (1900).

(51) Francis and Stevens, "High-Pressure Mercury Vapour Discharge and Its Applications", *J Inst Elec Engrs*, Part II, **94**, 423 (1947).

(52) Gebhard, "The Action of Light upon Dyed Shades and Standard Methods of Testing", *J Soc Dyers Col* **26**, 173 (1910).

(53) Gebhard, "Proposal for a Uniform Method of Testing the Fastness of Colours to Light", *Färber-Ztg* **22**, 6, 26 (1911).

(54) Gebhard, "Criticism of Krais" (cf Ref *80*) *Z angew Chem* **24**, 1807 (1911).

(55) Gebhard, "Improvement of the Fastness to Light of Dyed Materials", *Färber-Ztg* **25**, 393, 405 (1914).

(56) German Fastness Commission of the Society of German Chemists, Report of, *Z angew Chem* **27**, 57 (1914); *J Soc Dyers Col* **30**, 156 (1914).

(57) German Fastness Commission, Report of (Fourth Edition) (1928). Translated in part in *Am Dyestuff Reptr* **18**, 235 (1929); and "Fastness to Light of Dyed Textiles, Its Determination and Standardization", Krais, *ibid* **19**, 33 (1930).

(58) Gibson, "The American Dyer", p172, E L Freeman, Rhode Island, USA (1873).

(59) Godlove, "Uniformity of Grading of the American, British and German Light Fastness Standards", *Am Dyestuff Reptr* **39**, 215 (1950). Cf also *ibid* **39**, 912 (1950), and *ibid* **40**, 114 (1951).

(60) Goodings, "The Fading of Dyed Textiles", *ibid* **24**, 663 (1935).

(61) Gordon, "Testing the Fastness of Dyed Colors to Light, *Textile Colorist* **43**, 29 (1921).

(62) Greider, "Energy-Emission Data of Light Sources for Photochemical Reactors", *Ind Eng Chem* **23**, 508 (1931).

(63) Hadfield, "Light Sources for Testing the Fastness of Dyes", *J Textile Inst* **18**, T 527 (1927).

(64) Haley, "Criticism of Robson" (cf Ref *102*), *J Soc Dyers Col* **34**, 201 (1918).

(65) Hannay, "Effect of Certain Softeners on Light Fastness", *ibid* **28**, 20 (1912).

(66) Harrison, "The Action of Light on Colouring Matters", *ibid* **28**, 225 (1912).

(67) Hedges, "Humidity and the Fading of Dyestuffs on Wool", *ibid* **44**, 52 (1928).

(68) Hellot, "L'Art de la Teinture de la Laine", Paris (1734).

(69) Heermann, "Action of Light on Dyed Yarns and Fabrics", *Chem Ztg* **48**, 813, 834 (1924).

(70) Herzfeld, "Testing the Fastness of a Dyestuff", *J Soc Dyers Col* **14**, 176 (1898).

(71) Hirst, "A Proposed System of Tests for the Fastness of Dyestuffs on Wool", *ibid* **41**, 347 (1925).

(72) Holst, "A New Tool for Evaluating Color Transference", *Am Dyestuff Reptr* **34**, 500 (1945).

(73) Hummel, "Fast and Fugitive Dyestuffs", *J Soc Dyers Col* **6**, 187 (1890).

(74) Hummel, "Fast and Fugitive Dyes", *J Soc Arts* **39**, 535 (1890).

(75) Hunter, "An Accelerated Light Fastness Test in Use at the Shirley Institute", *J Soc Dyers Col* **56**, 64 (1940).

(76) Imperial Chemical Industries Ltd, "Fastness Assessment of Textile Dyestuffs", Kynock Press, Birmingham (1946).

(77) Jones, "Some Observations on the Action of Light on Finished Dyed Cotton Goods", *J Soc Dyers Col* **26**, 147 (1910).

(78) Knecht, Rawson and Loewenthal, "A Manual of Dyeing", Vol **II**, Charles Griffin, London (1893).

(79) König, "The Action of Light on Dyed Material", *Färber-Ztg* **24**, 366 (1913).

(80) Krais, "Proposed Scale for Measuring the Action of Light on Dyes According to Bleach Hours", *Z angew Chem* **24**, 1129, 1302, 1809 (1911).

(81) Lange, "What Treatments are to be Regarded as Satisfactory in the Examination of Dyestuffs with Respect to Fastness", *Färber-Ztg* **14**, 269 (1903).

(82) Lauer, "The Standard Fading Lamp at the National Bureau of Standards and Means of Calibrating Other Lamps in Terms of It", *Am Dyestuff Reptr* **34**, 264 (1945).

(83) Lead, "Artificial Light Fastness Tests on Coloured Textiles", *J Soc Dyers Col* **65**, 723 (1949).

(84) Leix, "Dyeing and Dyers' Guilds in Mediaeval Craftsmanship", *Ciba Rev* 1, 16 (Sept, 1937).

(85) Little, "Progress Made in International Colorfastness Standard Test Methods", *Am Dyestuff Reptr* **40**, 732 (1951).

(86) Luckiesh and Taylor, "The Fading of Colored Materials by Daylight and Artificial Light", *ibid* **14**, 613, 637 (1925).

(87) Lunge and Keane, "Technical Methods of Chemical Analysis", Vol **II**, Pt II, p944, Gurney and Jackson, London (1911).

(88) McLaren, "The Spacing of Scales for Assessing the Effect on the Pattern in Fastness Testing", *J Soc Dyers Col* **68**, 203 (1952).

(89) McLaren, "The Use of the Grey Scale for Assessing the Effect on the Pattern in Fastness Testing", *ibid* **68**, 205 (1952).

(90) McLaren, "The Development of the Geometric Staining Scale", *ibid* **69**, 285 (1953).

(91) Morton, "History of the Development of Fast Dyeing and Dyes". A lecture delivered before the Royal Society of Arts on February 20, 1929. Summary given in *ibid* **45**, 148, (1929).

(92) Morton, "Practical Assessment of Light Fastness", *ibid* **65**, 597 (1949).

(93) Mott, "Use of the Flame Arc in Paint and Dye Testing", *Trans Am Electrochem Soc* **28**, 371 (1915).

(94) Murray, "A Bibliography of Literature on the Fastness of Dyes", *Am Dyestuff Reptr* **10**, 123 and 160 (1922).

(95) Murray, "The Development of Tests for the Fastness of Dyestuffs", *ibid* **10**, 231, 344 (1922).

(96) Norton, "New Recommended Test Conditions and Operating Practices for Light Fastness Tests in the Fade-Ometer", *ibid* **43**, 628 (1954).

(97) "Pocket Manual for Dyers, Printers, Lake and Paper Makers on the Application of the Coal Tar Colours", Farbwerke vorm, Meister Lucius and Brüning, Hoechst on Main (1911).

(98) Rabe, "Present Position of the Determination of Light Fastness", *Textilber* **30**, 470, (1949); *Textile J Australia* **25**, 244 (1950).

(99) Rabe, "Über kunstliche Belichtungsquellen", *Textilber* **31**, 278 (1950).

(100) Rabe, "Bemerkungen zu den Richtlinien für die Bestimmung der Farbechtheit von Textilien", *Textil-Praxis* **9**, No. 11, 1052 (1954); *ibid* **9**, No. 12, 1165 (1954).

(101) Ris, "Über die Bestimmung der Farbechtheiten", *Textil Rundschau* **4**, 396 (1949); *Teintex*, No. 11 (Nov 15, 1949).

(102) Robson, "A Method of Standardizing the Fastness of Colors to Light", *J Soc Dyers Col* **34**, 185 (1918).

(103) Schaeffer, "Kritische Betrachtungen der Echtheitsprüfungen", *Textil-Praxis* **4**, 233 (1949).

(104) Scheurer, "Means of Measuring the Action of Light on Colors", *Bull soc ind Mulhouse* **68**, 119, 273 (1898).

(105) Scheurer, "Influence of Temperature and Humidity during Exposure to Light of Cotton Colors", *ibid* **70**, 328 (1900).

(106) Scheurer and Brylinski, "Means of Measuring the Action of Light on Colors", *ibid* **69**, 93 (1899).

(107) Scheurer, Schoen and Wild, "The Application of Actinometry as a Measure of the Resistance of Colors to Light", *ibid* **70**, 320 (1900).

(108) Schmidt and Gabler, "Influence of Sizing Materials on the Light Fastness of Cotton Dyeings", *Färber-Ztg* **25**, 153 (1914).

(109) Scott, "Standard Methods for Testing Dyestuffs", *Am Dyestuff Reptr* **7**, 14, (1920).

(110) "SDC Report on the Work of its Fastness Committee in Fixing Standards for Light, Perspiration and Washing", Society of Dyers and Colourists, Bradford, Yorkshire (1934).

(111) "SDC Fastness Tests Committee, Second Report", *J Soc Dyers Col* **64**, 133 (1948).

(112) "SDC Report of Committee on Dyeing Properties of Wool Dyes, Appendix III", *ibid* **66**, 219 (1950).

(113) SDC Fastness Tests Co-ordinating Committee, "The Development of the Geometric Grey Scales for Fastness Assessment", *ibid* **69**, 404 (1953).

(114) SDC Fastness Tests Co-ordinating Committee, "Proposed International Tests for Colour Fastness of Textiles", *ibid* **69**, 409 (1953).

(115) SDC Third Report of Fastness Tests Co-ordinating Committee, *ibid* **71**, 283 (1955).

(116) Staples, "Standardizing Test Methods for Textiles", *Can Textile J* **71**, 49 (Sept 10, 1954).

(117) Swiss Standards Association, "Textiles: Textile Testing Methods", *Am Dyestuff Reptr* **41**, 701 (1952).

(118) "The Colouring Matters of the Actien-Gesellschaft für Anilin-Fabrikation Berlin. Their Properties and Application in Textile Dyeing", Berlin (1904).

(119) Thommen, "Proposed System of Examination, Evaluation and Classification of Fastness of Dyes and Dyeing", *Teintex* **13**, 44 (1948).

(120) Thorpe, Hummel, et al, "The Action of Light Upon Dyed Colours", *J Soc Dyers Col* (1893, 1894, 1895, 1896, 1898 and 1900).

(121) Ure, "Dictionary of Arts, Manufactures and Mines", sixth edition, Vol 2, p123, Longmans, Green, London (1867).

(122) *Ibid*, p131.

(123) US Quartermaster Corps, "Test Methods for Textiles", Specifications, PQD 447A (Jan 19, 1945).

(124) Vass and McSwiney, "Fastness of Dyes to Perspiration. I. The Composition of Human Perspiration", *J Soc Dyers Col* **46**, 190 (1930).

(125) Wescher, "Dyeing in France before Colbert", *Ciba Rev* **18**, p620, (Feb, 1939).

(126) Wescher, "Great Masters of Dyeing in 18th Century France", *ibid* **18**, p631 (Feb, 1939).

(127) Wöscher, "The Fastness of Dyed Colors to Light and Air", *Z angew Chem* **7**, 211 (1891).

(128) Wood, "Calibration of Fade-Ometers", *Am Dyestuff Reptr* **31**, 595 (1942).

(129) Zuber, "Gegenwärtige Tendenzen in der Vereinheitlichung der Farbechtheisbestimmungen", *Textil Rundschau* 5, 15 (1950); 5, 41 (1950).

(130) Zuber, "La Détermination des Solidités des Teintures et sa Standardisation, Etat Actuel de la Question", *Teintex*, No. 11 (Nov 15, 1952).

Employment Register

This column is open for two insertions per year, per member, without charge. Blanks can be obtained from, and filed with, the secretary of the Association, Post Office Box 28, Lowell, Mass. It is understood that these will be open to inspection by prospective employers who can obtain further information from the secretary.

57-5

Education: Philadelphia Textile Institute.

Experience: 8 years hosiery dyeing supt. 20 years—sale of textile chemical specialties.

Age: 58; married; references

Position desired: chemical salesman.

Locations desired: New Jersey—Virginia. Any US location acceptable. Resume on request.

3-25, 4-8

57-6

Education: Brooklyn College, BA in chemistry; evening courses at Columbia, Rutgers and Boston Universities. Chemical and plastics engineering for chemicals, plastics.

Experience: 14 years.

Age: 37; married; references.

Position desired: product management; new product sales development or market development, preferably in textile chemical specialties.

Location desired: New York metropolitan area. New Jersey, Connecticut, New York state acceptable.

3-25, 4-8

57-7

Education: Washington College, BS in chemistry.

Experience: 15 years — chemical supervisor, dyehouse chemist, technical service—foreign and domestic—one company.

Age: 39; married; references.

Position desired: Supervisory, development or technical service.

Location desired: South or Southwest USA.

3-25, 4-8

New York

A dinner meeting of the New York Section, held March 1, 1957 at the Hotel Delmonico, New York, NY, with theme, "This is Color", attracted an attendance of 130.

Chairman Donald E Marnon, American Aniline Products, Inc, introduced V Lindsay Chase, Textile Colors Div, Interchemical Corp, who spoke on the subject and also presented a film of the same title. The film was a modernized adaptation of Volume II of the three monographs on color that Interchemical Corp had published twenty years ago. It explained the basic principles of color and its dependence on light.

Tickets for the dinner meeting were obtainable only in advance, as none were sold at the door. This was the first meeting of the Section under these arrangements, and it proved to be successful.

The next meeting of the Section will be held at Kohler's Swiss Chalet, Rochelle Park, NJ, on April 26th, at which time Raymond Thornton, Arnold, Hoffman & Co, Inc, will discuss "Procion Dyestuffs".

NBITT Student Chapter

THE New Bedford Institute of Textiles and Technology Student Chapter met on Friday, February 15, 1957, under the chairmanship of Joseph A Power, with sixteen persons present.

Mr Power advised that there would be an election for the offices of secretary and corresponding secretary at the next meeting of the Chapter.

A letter from Kenneth J Broden, The Sherwin-Williams Co, was read, advising that the Rhode Island Section's Student Night would be held at the Institute on April 25th. Mr Broden is chairman of the Section's Student Night Committee.

Following a lengthy period of discussion relative to a student award to be presented on Student Night, a motion was made and passed that an award winner be selected as follows:

"Each student member in good standing as of March 1, 1957, may submit five typewritten slogans designed to encourage textiles or to increase interest in textiles. These must be submitted by April 1, 1957. A code number will be assigned each contestant by Dean Silva or other impartial person, and this number will be placed on submitted slogans. The faculty of the chemistry department shall judge the winning slogan by any means they see fit".

Activities of the Local Sections

Behrendt

Pacific Southwest

MELVILLE H Behrendt, Catalina, Inc, Los Angeles, Calif, has been elected chairman of the Pacific Southwest Section, succeeding Robert A Fliegel, Allied Printers and Dyers, who has been elected councilor for the Section.

Also elected were Harold W Ellsworth, West Coast Carpet Dyers, *vice chairman;* Clarice H Lindsey, Univ of California, *secretary;* and William M Campbell, California Hand Prints, *treasurer.*

The Sectional Committee now consists of: Thomas P Lee, Geigy Dyestuffs; Walter E Kramer, Jenkins-Wright Co; Leon F Olson, Ciba Co, Inc; Theodore B Smock, Jr, General Dyestuff Co; and Angus H Roberts, Jacques Wolf & Co.

J Raymond Nehmens, E I du Pont de Nemours & Co, Inc, will serve as outing chairman; John Smith, Dyemasters, Inc, heads the Corporate Membership Committee.

Chairman Behrendt has asked the Section's Intersectional Contest Committee to continue its work on the effect of smog on fabrics and color. The Committee consists of Thomas P Lee; Rita Landry Kostecke, UCLA; Stephen N Burmer, U S Testing Co, Inc; Paul F Noonan, National Dyeing and Finishing Corp; and Walter F Wigglesworth, United Piece Dye Works. All interested persons in the industry are invited to work with this Committee. Progress has been made to a point where Mr Behrendt feels that it will be of national interest and importance.

To ensure that the activities of your Section receive proper publicity in the Proceedings, it is desirable that material be submitted direct to American Dyestuff Reporter, 44 E 23rd St, New York 10, N Y.

ADVANCE NOTICES OF MEETINGS——Copy must be submitted *at least two weeks* prior to the publication date. ADR is published on alternate Mondays. It is urged that that dates be taken into consideration when copy is submitted.

Advance notices should include the date and site of the meeting; the speaker's name, position, business affiliation, and subject; a short abstract of the paper (optional); details of additional meeting highlights, eg, nominations or election of officers, special awards, activities of Sectional committees, etc.

MEETING REPORTS——Complete reports should be submitted as soon as practical after a meeting. Information should include attendance figures; captioned photographs of meeting principals (speaker, section officials, etc); and any additional points not covered in the advance notice. An extensive resume of the speakers' remarks is not necessary if the paper is to be submitted for full publication in the Proceedings.

PAPERS——Two copies of each paper presented before local sections should be sent to the offices of the American Dyestuff Reporter. It is very important that every speaker be acquainted with the "Notice to Authors", which appear periodically in the Proceedings. Additional copies of said notice will be sent to section officials on request.

It is imperative that each Section appoint an official whose responsibility it is to see that the speaker's remarks are submitted. In cases where prepared manuscripts are not immediately available to the Section official, it may be necessary to acquaint the author with the address to which he should send his material when it is finally prepared.

In cases where the material is extemporaneous (panel discussions, question-and-answer periods, open forum, etc) it is the responsibility of the Section to provide for stenotype service, so that a complete record may be available.

PRESENTATION OF A PAPER BEFORE A LOCAL SECTION DOES NOT GUARANTEE PUBLICATION IN THE PROCEEDINGS. AS THE FINAL DECISION RESTS WITH THE AATCC PUBLICATIONS COMMITTEE. However, most papers will be acceptable provided they conform in content and layout to established practices of AATCC.

NOTICE TO AUTHORS OF PAPERS

MANUSCRIPTS for the *Proceedings* and for other publications of the American Association of Textile Chemists and Colorists shall conform to the requirements and standards given in this *Notice*. Before publication, manuscripts for the *Proceedings* shall be approved by the Editor, not only for editorial correctness according to the standards of this *Notice*, but also for content of technical matter. In his work, the Editor may enlist the aid of anonymous reviewers who are selected for expert knowledge in particular fields.

It is presumed that authors in studying the comments of reviewers and of the Editor will remember that all recommendations are made in a kindly, helpful, sympathetic manner to improve the paper in both literary and technical excellence. Although authors should cheerfully consider suggestions, they are expected to defend their position if justified, especially when strictly technical matters are involved with which the authors have an intimate knowledge.

AATCC strives to maintain a high scientific and professional standard for papers. Authors must make every effort to avoid the use of trade names, commercial products or process names wherever such use may be construed as advertising. Wherever possible, scientific nomenclature must be employed. It is recognized that in some instances trade names are necessary to avoid lengthy description. Certain trade names have been so widely used as to become generic and these normally are permissible. Further, some technical papers may involve the presentation of a new product or process wherein trade name reference is obligatory.

Giving due consideration to such valid exceptions, it is incumbent upon the author to maintain the proper scientific attitude, avoiding any expressions or devices aimed at promoting a particular product or process.

Questionable papers are to be referred to the chairman of the Publications Committee, who will submit them to an editorial board which would be appointed as needed. The Board would report to the Publications Committee, which would have the final voice in accepting or rejecting a paper.

MANUSCRIPTS — Manuscripts shall be typewritten double-spaced with approximately one-inch margins on 8.5x11-inch white paper. In addition to the *original*, at least one carbon copy is required. Pages are to be numbered consecutively with Arabic numerals, and each page after the first shall carry the authorship at the very top. Tables and figures shall also be numbered consecutively, the tables with headings containing Roman numerals as TABLE I, TABLE II, etc, and the figures with Arabic numerals as Figure 1, Figure 2, etc, appearing *below* the figures. The names of the authors and their laboratories or business connections should appear below the title of the paper.

LITERARY STYLE AND FORM OF PRESENTATION—In the writing of papers, authors are requested to observe a trenchant, simple style of writing directed to textile chemists and colorists with at least an elementary knowledge of chemistry, physics, mathematics, engineering, textile processes and textile machinery.

In the organization of the material, there should be one or more introductory paragraphs setting forth the occasion, significance and main objectives of the paper and of the method of attack. This should be followed by the body of the presentation, either with discussions interspersed throughout this portion or with a collected section marked "DISCUSSION" after the main body of the paper. Finally, there may be a brief section at the end entitled "SUMMARY" or "CONCLUSIONS."

Center and side headings make for easier reading. Center headings should be employed sparingly and generally will include only very important section headings, such as "INTRODUCTION," "EXPERIMENTAL," "DISCUSSION," "CONCLUSIONS," "SUMMARY," and "REFERENCES." Side headings (see sixth paragraph of this *Notice* for an example) shall be indented and run into the text to which they apply, and shall be separated from the paragraph by a dash. The publisher will print center headings in bold-face capitals and side headings in capitals.

LITERATURE REFERENCES AND FOOTNOTES—References to the literature and all footnotes (except those in tables) shall be numbered consecutively with underlined Arabic numerals in parentheses at the proper place in the text. Where a reference or footnote is to be used again, the original number is simply repeated; this obviates the necessity of repeating the footnote or reference at the bottom of the page. References to the literature shall conform to the universal usages followed by *Chemical Abstracts*, which include underlining of journal names to indicate italicization in printing.

The spelling and rules of punctuation followed in manuscripts shall be those found in the "Merriam-Webster New International Dictionary"; abbreviations and chemical formulas shall conform to *Chemical Abstracts*.

FIGURE AND GRAPHS—Figures and graphs should be black line drawings on white drawing paper. Photographic prints are acceptable, preferably glossy prints on double-weight paper. Duplicates should be available for dispatch to reviewers. In graphs the frame and actual curves should be inked more heavily than the co-ordinate lines, and these latter should not be too close together. Various styles of broken lines are sometimes desirable to distinguish curves. Experimental points should be given with small plane figures, such as circles, squares, diamonds or triangles. Numbers and legends on co-ordinate axes are to be lettered in the graph by the author. Numbers and titles of figures should be placed below the diagram or on the edge of the back. Each piece of illustration copy should bear on the margin or on the edge of the back the name of the author and the title of the paper.

SYNOPSIS—A separately written synopsis of not over 200 words containing the gist of the subject matter must accompany every manuscript.

GALLEY PROOFS—Galley proofs will be sent to the author by the publisher for correction before publication. This should not be interpreted as an invitation to re-write the paper but rather as an opportunity to correct errors.

REPRINTS — Fifty reprints of papers published in the *Proceedings* will be furnished without charge by the publisher if requested when galley proofs are returned. These reprints are printed on one side of the sheet only and then stapled together. A schedule of prices of reprints in the usual form accompanies the galley proofs.

OWNERSHIP OF COPYRIGHTS AND PATENTS—All papers presented at general meetings of the Association or at meetings of any of its local sections and all communications shall become the property of the Association. Such papers are not to be published elsewhere until they have appeared in the *Proceedings* of the Association. Papers published in the *Proceedings* are copyrighted by the Association. Any patentable disclosures shall of course remain the property of the author or authors.

TRADE-MARKS—As the AATCC wishes to co-operate in the protection of trade-marks, it is requested that, in the body of the article, trade-marks be written with an initial capital letter.

LETTER TO THE EDITOR

The Editor
American Dyestuff Reporter
44 E 23rd Street,
New York, N Y

Dear Sir:

As the representative of Stevensons (Dyers) Limited of Ambergate, Derbyshire, England, I was especially interested in the article entitled "An Investigation of Roller Printing on Wool", beginning on page P913 of the December 3, 1956 issue of the *American Dyestuff Reporter*, under *Proceedings of the AATCC*.

The article suggests several wool pretreatments, among them:

"A) An alkaline chlorination using sodium hypochlorite and potassium permanganate at a pH of 8-9."

and

"D) A treatment with Caro's acid (permonosulfuric acid, H_2SO_5) as a continuous method."

The reference to these methods, (*9*) and (*10*) respectively, do not clearly present the patent situation.

Method (A) is covered by the claims of Stevensons (Dyers) Ltd, US Patent 2,429,082, and the Caro's acid pretreatment method (D) is the subject of Stevensons (Dyers) US Patents 2,701,178 and 2,739,034 (copies enclosed).

In order to correct the false impression created by the article to the effect that the aforementioned methods are not the subject of issued patents, and further to properly credit the patent owner, I request that you publish this letter at an early date for the information of the trade.

Any communication looking to acquisition of rights under the above patents should be addressed to the writer as representative of Stevensons (Dyers) Ltd.

Faithfully yours,
M Stanley Brown
110 East 42nd St
New York 17, N Y

Membership Applications

SENIOR

Herman Brown—Textile chemist, A E Staley Mfg Co, Decatur, Ill. Sponsors: W B Broadbent, E H Grosse.

Allen H Howard—Vice pres, Original Bradford Soap Works, Inc, Providence, R I. Sponsors: W S Barnes, G P Andrew.

Peter J Hrynko—Lab assistant, Pharma Chemical Corp, Bayonne, N J. Sponsors: I M Buchholtz, S Wolf.

John W Kraushaar—Lab tech-colorist, Nyanza Color & Chemical Co, New York, N Y. Sponsors: J O'Day, L W Hansen.

Murray N Lefkowitz — Processing supt & finisher, Indian Orchard Fin Co, Indian Orchard, Mass. Sponsors: G O Linberg, V J Pappas.

Elbert B McMahon—Supt dyeing, Lawtex Corp, Dalton, Ga. Sponsors: M S Morrison, W F Crayton.

Naoyoshi Adachi—Supt of dyeing, Textile Res Lab of Asaki Chem Ind Co, Osaka, Japan. Sponsors: H W Stiegler, G J Mandikos.

John L Pierce—Mgr, Celand Yarn Dyers, Thomasville, N C. Sponsors: W F Okey, F C Munday.

Harvey B Powell — Mgr, Print Works Plant, Cone Finishing Co, Greensboro, N C. Sponsors: R H Souther, M J Gardner.

Richard W Whittle—Supt of dyeing & finishing, in charge of production, Caldwell Linen Mills, Iroquois, Ont, Canada. Sponsors: G A Wilkie, R W Redston.

JUNIOR

Owen C Tierney — Tech sales trainee, Becco Chem Div, Food Machinery & Chemical Corp, Buffalo, N Y. Sponsors: N Weinberg, B K Easton.

ASSOCIATE

Frank D Andruss—Vice pres, sales, General Latex & Chemical Corp, Cambridge, Mass.

Aurora H Balagot — Chief dyer, Floro Knitting Mills, Manila, Philippines.

Leroy J Davis—Tech sales repres, Alco Oil & Chemical Corp, Philadelphia, Pa.

Harold Frankel — Sale of dyes, Dawes Distributors Inc, Somerville, Mass.

John G Schoepf — Sales repres, General Latex & Chemical Corp, Cambridge, Mass.

STUDENT

Kyutae Rhee—Lowell Tech Inst. Sponsor: G R Griffin.

Anthony J Villani—Lowell Tech Inst. Sponsor: G R Griffin.

Albert O Barrette—New Bedford Inst of Text & Tech. Sponsor: F Tripp.

Richard Ormerod — New Bedford Inst of Text & Tech. Sponsor: F Tripp.

CORPORATE

Philadelphia Hosiery Mills

APPLICATION FOR TRANSFER TO SENIOR MEMBERSHIP

Lawrence M Flamberg, Wesley A Gaddes and Lee S Shefter.

The National Headquarters Office
of the Association
Will Accept Until Further Notice
PREPAID IN FULL SUBSCRIPTIONS
for
THE SECOND EDITION
of
THE COLOUR INDEX
IN FOUR VOLUMES
published by
The Society of Dyers and Colourists
and
The American Association of Textile Chemists
and Colorists
at
$99.00 The Set Delivered

IN THE TERRITORIES ASSIGNED TO THE ASSOCIATION. SHIPMENTS TO BE MADE VOLUME BY VOLUME AT TIMES CONSISTENT WITH PUBLICATION PROCESSING AND AVAILABILITY.

VOLUME I—PART 1 now available
Delivery of VOLUME II, PART 1 can be expected on or about April 1, 1957

BEING A LIMITED EDITION THE PROMPT PLACEMENT OF ORDERS THEREFOR IS SUGGESTED. WRITE TO:

American Association of Textile Chemists and Colorists
Box 28, Lowell, Massachusetts

EXAMPLE OF ENTRY IN PART I

C.I. 69025 Anthraquinone **C.I. Vat Orange 1**

APPLICATION

DYEING

METHOD
A/Q1 ☐
A/Q2 ■
A/Q3 ◘
Indigoid ☐

LEUCO COMPOUND
Alkaline, orange brown
Acid, brownish yellow

PROPERTIES (COTTON) Affinity and levelling, good. For data on strike, levelling and migration see *JSDC*, **66** (1950), 505
Suitable for pigment pad-jig, pad-steam, continuous piece and vat-acid processes

Vat in short liquor

Cotton Affinity and levelling good. Dead cotton covered fairly well
Viscose Good affinity at low temperature; at high temperature the hue is redder and duller
Cotton/Viscose Good solidity when dyed cold. At 50°C viscose dyed heavier than cotton
Silk Suitable

PRINTING

Cellulose Applied by normal processes giving redder and duller hues than when dyed. Dischargeable in pale and medium shades in the presence of an assistant

FASTNESS PROPERTIES etc

	A	B	C
CROSS DYEING (Chrome)	..	5	5
HOT PRESSING ...	5	5	5
HYPOCHLORITE ...	5	5	5
LIGHT ¼–½ Normal	5–6	6	6
Normal	6–7	6–7	6
2× Normal	..	7	6–7

	A	B	C
MERCERISING ...	5	5	5
PEROXIDE BLEACHING	5	5	5
SODA BOIL (open kier)	4–5	5	5
SODA BOIL followed by HYPOCHLORITE ... (Combined test)	4–5	4–5	..

Tendering on exposure to light not accelerated

FASTNESS ON SILK (B) Degumming 5, Hot pressing 5, Light 6–7, Peroxide bleaching 4–5

TEXTILE USAGE

DYEING

Cellulose On account of good level dyeing and all-round fastness as a shading colour where good light fastness is required. Suitable for curtains, hangings and for goods to be bleached, e.g. shirtings and towels

Silk For good fastness to degumming, peroxide bleaching and washing

Unions For cotton/viscose fabrics

PRINTING

Cellulose For direct print styles or as pigment with binder on cotton and viscose

HUE **Yellowish Orange**
ARTIFICIAL LIGHT: redder

Benzadone Gold Orange 3G	**YDC**
Caledon Gold Orange 3G	**ICI**
Carbanthrene Golden Orange 3G ...	**NAC**
Cibanone Golden Orange 3G	**Ciba**
Cibanone Golden Orange 3G℗ ...	**Ciba**
Fenanthren Golden Orange 3G ...	**G**
Indanthren Golden Orange 3G ...	**FBy**
Indanthrene Golden Orange 3GA ...	**G**
Indanthrene Golden Orange 3GF ...	**G**
Indanthrene Golden Orange 3GWP ...	**G**
Ponsol Golden Orange 3G	**DuP**
Ponsol Golden Orange 3GD	**DuP**
Sandothrene Golden Orange N3G ...	**S**
Solanthrene Orange 3J	**Fran**
Tinon Chlorine Golden Orange 3G ...	**Gy**

Reactions on Cellulose
H_2SO_4 conc.— greenish blue

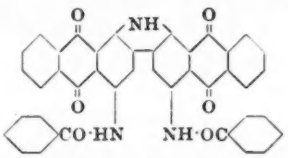
An example from the Vat dyes section of Part I is reproduced above and a specimen page (carbazole vat dyes) from the Anthraquinone section of Part II is shown opposite.

These two examples illustrate the information which appears in Parts I and II and demonstrates the dual reference system which connects the two Parts, e.g.

C.I. Vat Orange 1 in Part I and **C.I. 69025** in Part II are complementary.

The format for the dyes in Part I varies with the amount of information available. Some dyes occupy a whole page, others only part of a page. For example, the space occupied by these notes may be used to accommodate information on **C.I. Vat Orange 2.**

69005 **C.I. Vat Green 9** (*Brownish grey → Dull olive*)



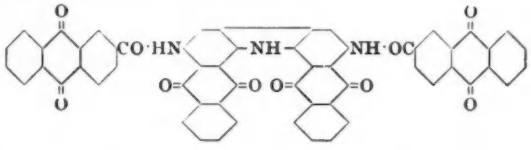
(*a*) Condense 1-benzamido-4-chloroanthraquinone with 1-amino-4-benzamidoanthraquinone in presence of copper and cyclise with chlorosulfonic acid
(*b*) Cyclise 4,4′-dibenzamido-1,1′-dianthrimide in sulfuric acid and oxidise the product

$Na_2S_2O_4$, alkaline — reddish brown; acid — yellowish brown

Discoverer — W. Mieg 1910
Bayer Co., *BP* 2702/09, 11932/09, 25986/09, 29352/10, 15753/12; *USP* 986521, 996109; *FP* 400653, 409407, 432449; *Sw.P* 55556; *GP* 220581, 225232, (*Fr.* **9**, 764, 1197), 228992, 239544, (*Fr.* **10**, 644, 638), 464292 (*Fr.* **16**, 1354)
Brit. Dye. Corp., *BP* 289191
BIOS 1493, 29; *FIAT* 1313, **2**, 135
FIAT 764 — Indanthrenoliv R
Vlies, *JSDC*, **30** (1914), 29
Fierz-David, 584 and Suppl. 82
Houben, 466, 662
Mayer, 181
Fierz-David & Blangey, Table 19
Fraser-Thomson, *JSDC*, **52** (1936), 242
Thorpe, **1**, 422

Soluble in *o*-chlorophenol
Slightly soluble in chloroform, pyridine
Insoluble in acetone, alcohol, toluene, xylene
H_2SO_4 conc. — red; on dilution — flocculent olive green ppt.

69010 **C.I. Vat Green 22** (*Olive*)

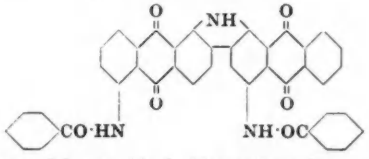


Condense 4,4′-diamino-1,1′-dianthrimide with 2 mol. 2-anthraquinonecarbonyl chloride and cyclise

Discoverer — F. Baumann 1929
I.G., *BP* 349714; *USP* 1819014; *FP* 696423; *GP* 513608 (*Fr.* **17**, 1398)
BIOS 1493, 28
FIAT 764 — Indanthrenoliv 3G

H_2SO_4 conc. — yellowish brown
$Na_2S_2O_4$, alkaline — reddish brown; acid — brownish yellow

69015 **C.I. Vat Brown 5** (*Brown*)



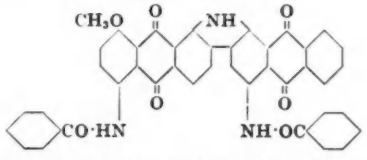
Condense 1-benzamido-5-chloroanthraquinone with 1-amino-4-benzamidoanthraquinone in presence of copper and cyclise with sulfuric acid

$Na_2S_2O_4$, alkaline — reddish brown; acid — yellowish brown

Discoverer — W. Mieg 1910
Bayer Co., *BP* 2702/09, 11932/09, 25986/09, 29138/09, 29352/10, 15753/12; *FP* 400653, 432449; *GP* 220581, 225232, (*Fr.* **9**, 764, 1197), 228992, 239544, (*Fr.* **10**, 644, 638), 491428 (*Fr.* **16**, 1349)
Brit. Dye. Corp., *BP* 289191
BIOS 1493, 10, 12; *FIAT* 1313, **2**, 106
FIAT 764 — Indanthrenbraun R, FFR
Fierz-David, 576 and Suppl. 82
Mayer, 181
Fraser-Thomson, *JSDC*, **52** (1936), 243
Thorpe, **1**, 422

Slightly soluble in xylene
H_2SO_4 conc. — dull wine red; on dilution — reddish brown flocculent ppt.

69020 **C.I. Vat Brown 36** (*Reddish brown*)

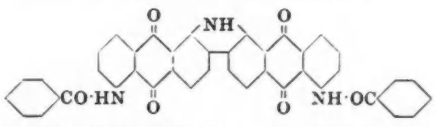


(*a*) Condense 1 - amino - 4 - benzamidoanthraquinone with 1 - benzamido-5-chloro-4-methoxyanthraquinone and cyclise
(*b*) Condense 1 - amino - 4 - benzamidoanthraquinone with 1 - benzamido-5-chloro-4-hydroxyanthraquinone, methylate the hydroxy group and cyclise with sulfuric acid

Discoverer — F. Baumann 1926
I.G., *BP* 298696; *USP* 1885172; *GP* 481362 (*Fr.* **16**, 1326)
BIOS 1493 44
FIAT 764 — Indanthrenrotbraun 5RF
Fox, *JSDC*, **65** (1949), 513

H_2SO_4 conc. — violet; on dilution — red
$Na_2S_2O_4$, alkaline — brown; acid — brown (yellower)

69025 **C.I. Vat Orange 1** (*Yellowish orange*)



(*a*) React 5,5′-dibenzamido-1,1′-dianthrimide with sulfuric acid and oxidise
(*b*) React 1-benzamido-5-chloro-anthraquinone with 1-amino-5-benzamidoanthraquinone in the presence of nitrobenzene and cupric chloride

Discoverer — P. Fischer 1910
Bayer Co., *Sw.P* 115114
Cassella Co., *GP* 239544 (*Fr.* **10**, 638), 249000 (*Fr.* **11**, 621)
BIOS 1493, 15, 77; *FIAT* 1313, **2**, 119
FIAT 764 — Indanthrengoldorange 3G
Fierz-David Suppl. 82
Thorpe, **1**, 423

Slightly soluble in nitrobenzene, tetralin, xylene
Insoluble in alcohol
H_2SO_4 conc. — greenish blue; on dilution — orange
$Na_2S_2O_4$, alkaline — yellowish brown; acid — yellow

CONTENTS

The work has been completely re-designed and brought up-to-date with the co-operation of all the dye manufacturers in Great Britain, America, Western Europe, India and Japan. The 2nd Edition is in three main parts.

PART I

PART I— consists of two volumes each of approximately 1,000 pages. It deals with all commercially homogeneous dyes and pigments in current use (approximately 4–5,000 dye entities and 25,000 commercial names) within groups relating to their main usage, e.g. Disperse, Acid, Azoic, Direct, Pigment, Solvent etc. The data included comprises the commercial name and manufacturer's initials, methods of application, fastness properties, established usages, reactions on the fibre and literature references relating to application. In the absence of a single accepted international system of fastness assessment it has been necessary, in this Edition, to make provision for the inclusion of data according to one or more of the following—

A— (American) The methods of The American Association of Textile Chemists and Colorists.
B— (British) The methods of The Society of Dyers and Colourists.
C— (Continental) The methods of the Deutsche Echtheitskommission.

An important feature of PART I is the sub-division of each usage group into hue groups— Yellow, Orange, Red, Violet, Blue, Green, Brown and Black. The hue classification has been made by reference to a Hue Indication Chart which has been designed specially for the purpose. A copy of the chart is included with each set of volumes.
Each dye or group of identical dyes carries a PART I serial name and number, e.g. **C.I. Vat Orange 1**, and also a five digit PART II number in those cases where the chemical constitution of the dye is known.

VOLUME 1 Foreword — Preface — Contents of Volumes 1-4 — Introduction to Part I
Acid Dyes (including the premetallised dyes) — Mordant Dyes — Basic Dyes — Disperse Dyes — Natural Dyes and Pigments — Food (Food, Drug and Cosmetic) Dyes

VOLUME 2 Direct Dyes — Sulphur Dyes — Vat Dyes — Ingrain Dyes — Azoic Dyes (sub-divided into Coupling Components, Diazo Components and Azoic Compositions) — Oxidation Bases — Pigments (inorganic and organic) — Solvent Dyes — Fluorescent Brightening Agents — Developers — Reducing Agents

PART II

PART II— is one volume of approximately 700 pages. It contains data relating to chemical constitution, method of preparation, patent and literature references relating to manufacture or constitution, solubilities and reactions in substance for approximately 3,800 dyes and pigments. The 1st Edition recorded 1,316 constitutions, and this very big increase is partly due to the fact that many co-operating dye manufacturers have, for the first time, disclosed the constitution of certain of their dyes. In addition there is the information contained in the reports compiled by Allied Investigating Commissions on the German Dyestuff Industry.

The dyes are arranged in order based on their chemical constitution following broadly the lines of the 1st Edition. A number of refinements have been introduced and there are two new sections, viz— AZOIC (the coupling components and the diazo components for the production of Insoluble Azo dyes on the fibre) and PHTHALOCYANINE.

Each entry carries a five digit reference number. These numbers do not progress in unit steps as provision has been made to allow the insertion of new constitutions in later editions or supplements without having to change the numbers now allocated in the 2nd Edition. Each entry also carries the complementary PART I serial name and number thus providing easy cross reference to the data in PART I. It also contains alphabetical and empirical formula indexes to all the Intermediates relating to individual dye entities.

VOLUME 3 Introduction — Nitroso — Nitro — Azo — Azoic — Stilbene — Ketonimine — Triphenylmethane — Xanthene — Acridine — Quinoline — Methine — Thiazole — Indamine — Indophenol — Azine — Oxazine — Thiazine — Sulphur — Lactone — Aminoketone — Hydroxyketone — Anthraquinone — Indigoid/Thioindigoid — Phthalocyanine — Natural — Oxidation — Inorganic Pigments — Alphabetical index of Intermediates — Empirical formula index of Intermediates

PART III

PART III— is one volume of approximately 400 pages containing the general index to PART I and PART II (see CONTENTS, [IV]). The Commercial Names Index includes the names (in italics) of dyes not in current use, many of which are related to data in PART I and/or PART II.

VOLUME 4 Hue Indication Chart (in pocket) — Dye Manufacturers' Initials (in alphabetical order) and Names — Dye Manufacturers' Names (in alphabetical order) and Initials — Abbreviations used in Parts I and II — Fastness Tests etc — Patents Index — Conversion Tables relating Colour Index 1st Edition to Colour Index 2nd Edition numbers and Schultz Farbstofftabellen (7th Edition) numbers to Colour Index 2nd Edition numbers and to AATCC Prototype numbers — Commercial Names Index — Additions and Corrections

ORGANIZATION OF THE AATCC

National Officers of the Association

President ..... GEORGE O LINBERG, Synthron, Inc, 19 Kirkstall Rd, Newtonville 60, Mass
Vice President (Central Atlantic Region) ..... WELDON G HELMUS, Fair Lawn Finishing Co, Fair Lawn, N J
Vice President (New England Region) ..... ERNEST R KASWELL, Fabric Research Laboratories, Inc, 1000 Providence Highway, Dedham, Mass
Vice President (Southern Region) ..... H GILLESPIE SMITH, American Cyanamid Co, 1370 Spring St N W, Atlanta 9, Ga
Vice President (Western Region) ..... ELLIOTT MORRILL, The Best Foods, Inc, 1437 West Morris St, Indianapolis 6, Ind
Executive Secretary-Assistant Treasurer ..... GEORGE P PAINE, P O Box 28, Lowell, Mass
Assistant Secretary ..... RICHARD R FREY, P O Box 28, Lowell, Mass
Treasurer ..... ROLAND E DERBY, Textile Aniline & Chem Co. Box 899, Lawrence, Mass
Treasurer Emeritus ..... WILLIAM R MOORHOUSE, P O Box 353, South Yarmouth, Mass
Founder ..... LOUIS A OLNEY (Deceased)
Director of Research ..... HAROLD W STIEGLER, Lowell Technological Institute, Lowell, Mass

Standing Committees of the Council

Executive Committee on Research ... CHARLES W DORN, *Chairman*
Technical Committee on Research ..... C A SYLVESTER, *Chairman*
Publicity ..... JAMES A DOYLE, *Chairman*
Appropriations ..... ROLAND E DERBY, *Chairman*
Membership and Local Sections ..... WELDON G HELMUS, *Chairman*
Publications ..... WALTER M SCOTT, *Chairman*
Corporate Membership ..... ALBERT E JOHNSON, *Chairman*
Constitution and Bylaws ..... WILLIAM A HOLST, *Chairman*
Conventions ..... FREDERICK V TRAUT, *Chairman*
Technical Programs ..... J EDWARD LYNN, *Chairman*
Technical Supplies ..... GEORGE P PAINE, *Chairman*

Student Chapters

ALABAMA POLYTECHNIC INSTITUTE, BRADFORD DURFEE TECHNICAL INSTITUTE, CLEMSON COLLEGE, FAIRLEIGH DICKINSON COLLEGE, GEORGIA INSTITUTE OF TECHNOLOGY, LOWELL TECHNOLOGICAL INSTITUTE, NEW BEDFORD INSTITUTE OF TEXTILES AND TECHNOLOGY, NORTH CAROLINA STATE COLLEGE, PHILADELPHIA TEXTILE INSTITUTE, RHODE ISLAND SCHOOL OF DESIGN, UTICA TECHNICAL INSTITUTE

Councilors

Representing Sections

NEW ENGLAND REGION

Northern New England: PHILIP S DURFEE, JOHN J HEALY, FRANK J RIZZO
Rhode Island: FRANCIS H CASEY, EDWARD H GAMBLE, RAYMOND B TAYLORSON, J WILLIAM TIMPERLEY
Western New England: RAYMOND J CAREY, J EDWARD LYNN

CENTRAL ATLANTIC REGION

Delaware Valley: CARLETON T ANDERSON, WILLIAM H BERTOLET III, ARTHUR W ETCHELLS, CLARENCE A SEIBERT, RICHARD A SHIMP
Hudson Mohawk: IRWIN J SMITH
New York: WILLIAM F BROMMELSIEK, PERCY J FYNN, JOHN H HENNESSEY, ARTHUR J KELLNER, HARRY MOORE, ROBERT L STUTZ, MAX WINKLER
Niagara Frontier: BERNARD K EASTON

SOUTHERN REGION

Piedmont: A HENRY GAEDE, CLARENCE HOOPER, JOHN V KILLHEFFER, HENRY A RUTHERFORD, R HOBART SOUTHER, PAUL B STAM
South Central: JACK ANDERSON
Southeastern: ROBERT B HALLOWELL, T HOWARD McCAMY
Washington: LAWRENCE L HEFFNER

WESTERN REGION

Mid-West: ERIC W CAMP, JOSEPH H JONES, J GORDON STOTT
Pacific Northwest: HUBERT DESMARAIS
Pacific Southwest: ROBERT A FLIEGEL

Past Presidents

ELVIN H KILLHEFFER, P J WOOD, WILLIAM H CADY, ALBAN EAVENSON, CARL Z DRAVES, THOMAS R SMITH, WILLIAM D APPEL, HENRY F HERRMANN, C NORRIS RABOLD, J ROBERT BONNAR, RAYMOND W JACOBY

Local Section Officers

New England Region

NORTHERN NEW ENGLAND

Chairman ..... EDWARD B BELL, Textile Aniline & Chemical Co, 49 Blanchard St, Lawrence, Mass
Secretary ..... AZEL W MACK, Dexter Chemical Corp, 100 Memorial Dr, Cambridge 42, Mass.
Vice Chairman—R D ROBINSON *Treasurer*—W W PENNOCK

RHODE ISLAND

Chairman ..... REMUS F CAROSELLI, Owens-Corning Fiberglas Corp, Ashton, R I
Secretary ..... JAMES J DILLON, King Phillip Finishing Co, Lonsdale, R I
Vice Chairman—T LARSON *Treasurer*—H STURTEVANT

WESTERN NEW ENGLAND

Chairman ..... THOMAS J GILLICK, JR, American Felt Co, Glenville, Conn
Secretary ..... ANDREW W GOODWIN, Princeton Knitting Mills, Watertown, Conn
Vice Chairman—J J CERVINI *Treasurer*—P P DuBIEL

Central Atlantic Region

DELAWARE VALLEY (formerly Philadelphia)

Chairman ..... DONALD W ROBINSON, Para-Chem, Inc, Philadelphia 34, Pa.
Secretary ..... ERNST W EMPTING, General Dyestuff Co, 123 South 2nd St, Philadelphia, Pa
Vice Chairman—W S SOLLENBERGER
Treasurer—A E STUTZKE

NIAGARA FRONTIER

Chairman ..... WILLIAM H LEYKING, National Aniline Div, Allied Chemical & Dye Corp, 1015 S Park Ave, Buffalo, N Y
Secretary ..... NORBERT WEINBERG, Becco Chemical Div, Food Machinery & Chemical Corp, Sta B, Buffalo 7, N Y
Vice Chairman—K A LISTER *Treasurer*—A M VIDITZ-WARD

HUDSON-MOHAWK

Chairman ..... ALBERT E HERRMANN, JR, General Aniline Works, Rensselaer, N Y
Secretary ..... MAURICE FISHMAN, Lee Dyeing & Finishing Co, Johnstown, N Y
Vice Chairman—E A CHEVRETTE *Treasurer*—J W MERRILL

NEW YORK

Chairman ..... DONALD E MARNON, American Aniline Products, Inc, 50 Union Sq, New York 3, N Y
Secretary ..... RICHARD P MONSAERT, JR, Puritan Piece Dye Works, Inc, 550 E 38th St, Paterson, N J
Vice Chairman—J A KOMNINOS *Treasurer*—R E MILLER

Southern Region

PIEDMONT

Chairman ..... CLEMENT O STEVENSON, Ciba Co, Inc, 1517 Hutchison Ave, Charlotte, N C
Secretary ..... LINTON C REYNOLDS, Riegel Textile Corp, Box 393, Ware Shoals, S C
Vice Chairman—W E RIXON *Treasurer*—J C KING

SOUTH CENTRAL

Chairman ..... J C WHITT, Standard-Coosa-Thatcher Co, Chattanooga 1, Tenn
Secretary ..... FRANKLIN E CATER, Ray-Ser Dyeing Co, Box 5037, Chattanooga 6, Tenn
Vice Chairman—E V HELMS *Treasurer*—E F JURCZAK

SOUTHEASTERN

Chairman ..... JAMES W SWINEY, Fulton Bag & Cotton Mills, Atlanta, Ga.
Secretary ..... EDWARD R RAVENEL, Morton Salt Co, 538 E Ponce de Leon Ave, Decatur, Ga.
Vice Chairman—W B GRIFFIN *Treasurer*—W B FAYSSOUX

WASHINGTON

Chairman ..... GEORGE P FULTON, National Institute of Dry cleaning, Inc, 909 Burlington Ave, Silver Spring, Md
Secretary ..... NELSON F GETCHELL, National Cotton Council of America, 1832 M St, Washington 6, D C
Vice Chairman—A M SOOKNE *Treasurer*—L R MIZELL

Western Region

MID-WEST

Chairman ..... SAMUEL M LITTLEJOHN, Munsingwear, Inc, 718 Glenwood Ave, Minneapolis 5, Minn
Secretary ..... WARREN B BROADBENT, Geigy Dyestuffs, 629 West Washington Blvd, Chicago, Ill
Vice Chairman—J G KELLEY *Treasurer*—K M HARMS

PACIFIC NORTHWEST

Chairman ..... THOMAS B KAY, JR, Thomas Kay Woolen Mills, 760 South 12th St, Salem, Ore
Secretary ..... FREDERICK H IHLENBURG, National Aniline Div, Allied Chemical & Dye Corp, 730 Burnside St, Portland 9, Ore
Vice Chairman—B R KOENIG *Treasurer*—D W KIMSEY

PACIFIC SOUTHWEST

Chairman ..... MELVILLE H BEHRENDT, Catalina, Inc, 443 South San Pedro St, Los Angeles 13, Calif.
Secretary ..... CLARICE H LINDSEY, Univ of Calif, Dept of Home Economics, Los Angeles 24, Calif
Vice Chairman—H W ELLSWORTH *Treasurer*—W M CAMPBELL

• PATENT DIGEST •

PAUL WENGRAF

APPLYING NYLON EMULSIONS TO NYLON FABRICS G,2,01

USPat 2,746,941 (H C Bick——Horn Jr, Patt——May 22, 1956)

An undesirable characteristic of nylon fabrics is the lack of moisture adsorption. As a result, the nylon garment feels sticky in summer and clammy in winter. The objective of the current invention is to make nylon fabrics more water-adsorbent.

This problem reportedly is solved by impregnating the nylon fabrics, especially knitted goods, with an emulsion of the dispersible nylon-derivative *Type 8 nylon* (N-methoxy methyl polyhexamethylene adipamide . . . USPat 2,430,860). A stable emulsion is obtained by mixing it with A) a nonionic emulsifier and B) with a stabilizing carbohydrate ester.

"A" is, preferably, an alkyl phenyl-ether of polyethylene glycol, eg, Tergitol Dispersant NPG 101 of Carbide and Carbon Chemicals Co, ie, octylphenol condensed with 9 mols ethylene oxide.

"B" is generally sucrose octoacetate.

A water-miscible solution is provided when 40 lbs of type 8 nylon is stirred with equal amounts of A) and B), 864 lbs of methanol (or ethanol) and 216 lbs of water. This emulsion is applied together with other ingredients in a finishing bath, and is set by subsequent drying, obviously by breaking the emulsion in contact with the fibers. Some acid, such as citric, is added for this purpose. A softer and silkier hand, pliability and warmth of the goods are claimed. Moisture is said to be more quickly absorbed and dispersed by the fabrics so treated. A chemical reaction between fibers, emulsion and the bonding agents is assumed.

Reference cited by the Patent Office:

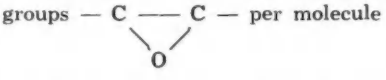
USPat 2,405,965 (Du Pont/1946) covers a method for coating or finishing with emulsions of synthetic linear polyamides (thus *nonmodified* nylon), which are obtained by dissolving the substance in a mixture of a high-boiling alcohol (cyclohexanol) and another solvent, protective colloids and anion-active agents.

CREASEPROOFING OF CELLULOSIC TEXTILES———Polyepoxy Compounds Applied G,2,04

USPat 2,752,269 (Shell Development Co——Condo, Schroeder——June 26, 1956)

It is stated that customary crease-proofing processes based on the application of amine-formaldehyde resin finishes have the drawback of chlorine retention; moreover, some of these finishes are not sufficiently wash resistant.

The object of this specification is to provide a crease- and shrink-resistant, resilient finish, having no chlorine-retention property. This and other superior effects reportedly are obtained by impregnating with a polyepoxide solution in the presence of a curing agent. Polyepoxide compounds containing at least two epoxy groups



per molecule must be used in this method. Numerous types of these compounds may be applied, eg, glycidyl polyethers of polyalcohols obtained by condensing glycerol with epichlorohydrin, also glycidylethers of dihydric phenols (also bis phenols), and many other compounds of the aliphatic or aromatic series. The aliphatic derivatives generally are soluble in water or aqueous alcohols, while the dihydric phenol derivatives must be applied in solvent solutions or in the form of emulsions.

Preferred curing agents include organic acids of chain length C_2—C_{12}, also inorganic acids or their anhydrides. Softeners and plasticizers may be added. The concentration on polyepoxides may vary from 3 to 20%.

Example: 100 p of a glycidylpolyether of glycerol (Polyether B), of a mol weight about 324, was dissolved in 160 p isopropanol plus 420 p water; 20 p citric acid was added. A cotton cloth was padded in this solution with a wet pickup of 65%. After drying at 60° C for 15 min and being cured for 5 min at 160° C, the goods were washed in warm soap-soda ash solution, rinsed and dried. Softness, excellent wrinkle-resistance, good tear and tensile strength, durability and lack of chlorine retention were reported.

Among the references cited by the Patent Office:

USPats 2,494,295 and 2,511,913 (Devoe & Raynolds/1950) describe a combination of sulfonamide or aromatic amine-formaldehyde resins with epoxy resins.

USPat 2,606,810 (Am Cyanamid/1952) covers a method for the shrink-proofing of wool by copolymerizing the monomers of acrylates and the like with unsaturated compounds containing epoxy groups [cf *Am Dyestuff Reptr* **42**, 213 (1953)].

PRINTING WITH SOLUBILIZED (ACYLATED) AZODYES——Fixation by Peroxides Containing Alkaline Media D,2,03

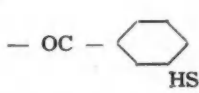
USPat 2,753,239 (Ciba Ltd——Graenacher, Bruengger——July 3, 1956)

The application of a dyestuff group, obtained by the acylation of sparingly soluble azodyes, to cellulosic textile fibers is described in Ciba's USPats 2,095,600 and 2,170,262. These dyes are known in the trade as Neocotones. The solubilizing acyl group is split off after printing (or dyeing) by alkaline hydrolysis, and by this means the original dyestuff is fixed on the fibers.

Several difficulties have been noticed in hydrolyzing off the acyl group, due to the specific acyl radicle and to the dyestuff's constitution. Dyes that contain a benzoyl mono- or disulfonic acid residue, for example, are very resistant to hydrolyzing.

Surprisingly, it has been observed that the aforementioned dyes can be fixed easily by hydrolyzation in an alkaline liquid containing a water-soluble peroxy compound, such as sodium perborate, sodium percarbonate or the like. A small amount of a salting-out substance, such as NaCl or Na_2CO_3, should be added. The per compounds were found to act in low concentrations and in a very short time (1-2 min passage), making it possible to dye in a continuous process. The highly concentrated alkalies and elevated temperatures used in the past may be avoided completely, according to the current method.

Example: A red, insoluble monoazo dye solubilized with 2 mols benzoic acid chloride-3-sulfonic acid, therefore containing twice the grouping



was dissolved in a mixture of water and thiodiglycol (Glycerine A) and pasted with starch tragacanth thickener. Prints made with this paste were dried, aged and developed at room temperature for 1-2 min in a bath containing 50 p anhydrous Na_2CO_3, 4 p NaOH, and 2 p sodium

perborate in 1000 p water. The prints were rinsed cold, the starch was solubilized by enzyme preparation, and soaping was done at the boil. A bright red resulted. When perborate was omitted in this formula, part of the dye bled off in the developing bath.

Among the references cited by the Patent Office:

USPat 2,187,453 (Ciba/1940) calls for fixing dyes of the above type with alkalies in the presence of salts, eg, K Cl or NaCl, to reduce the solubilities of the acyl derivatives.

USPat 2,204,932 (Ciba/1940) calls for carrying out fixation with alkaline agents in vapor form, eg, ammonia, alkylamines and so on.

BLUE AZODYES ON CELLULOSE ACETATE———Developed in Presence of Nonionic Agents

C,4,07

USPat 2,754,171 (Celanese Corp of Am—Salvin—July 10, 1956)

The same inventor's USPat 2,643,175 of June 23, 1953 [cf *Am Dyestuff Reptr* 43, 213 (1954)] protects an improved dyeing process for acetate fibers with azodyes formed *in situ*, comprising diazotization under low acidity conditions (eg, by using organic instead of mineral acids) and development in alkaline (soap) solution containing a swelling agent. The low acidity reduces the amount of undesirable nitrosonaphthols, which otherwise form as by-products and impair the fastness and pure shade of the dye. This effect is particularly conspicuous in the dyeing of blue azodyes of the Naphthol-AS series.

The current patent is a continuation-in-part of USPat 2,643,175. It has been discovered that valuable blue shades of the Naphthol-AS series can be produced *in situ* if certain nonionic surfactants are present during coupling.

A list of appropriate nonionics is given, containing, among others, Alrosol C (reportedly a condensate of capric acid and diethanolamine) and Atlas G 1020 (polyoxyethylene sorbitol laurate). The use of the latter has been protected by the claims, while Alrosol is mentioned in the examples.

Example: A cellulose fabric was dyed for one hour in a mixture of a diazotable amine and o-toluidide of beta-oxynaphthoic acid. A second bath upon diazotization with acetic acid and nitrite yielded a blue shade. The fabric was rinsed and developed for one hour at 75° C in a bath containing 1% of soap and 1.75% by vol Alrosol C. A clear blue shade reportedly was obtained. A *commercially nonacceptable* violet color resulted when the nonionic surfactant was omitted.

The specification emphasizes that *not all nonionic* agents have this effect. The greatest improvement is said to result from the application of alkanolamine — fatty acid condensates, such as Alrosol C.

Among the references cited by the Patent Office:

USPat 2,048,786 (Celanese/1936) blue azodyes of the naphthol series may be produced *in situ* by application, in the first bath, of a naphthol component in free state and a diazotizable diarylamine.

Brit Pat 380,851 (I G Farben/1932) water-insoluble amines and carboxylic acids may be reacted with ethylene oxide to give water-soluble textile assistants.

WATER-REPELLENT SILICONE RESINS———Emulsified with Stannous Hydroxide in Alkaline Medium

G,2,02

USPat 2,750,305 (Dering Milliken Res Corp—Gagarine, Repokis—June 12, 1956)

When silicone resins are to be used as water repellents, they frequently are applied from aqueous emulsions; another emulsion may contain the necessary catalyst. During drying, silicone particles present in the oil phase tend to coalesce and to mix with the catalyst. It has been observed that, in this procedure, the resin dries in the form of *discrete particles*, thus producing a nonuniform hydrophobic coating. Other disadvantages are that the emulsifying agent may act as a rewetting agent (therefore requiring complete removal by further washing), and that relatively high curing temperatures are required, precluding application on some thermoplastic fibers. On the other hand, impregnation with the silicone resins from organic solvent solutions to obtain high and uniform water repellency has many other drawbacks, such as health and fire hazard and excessive costs.

According to the current invention, silicone resins may be emulsified by using the ammonium salt of an organic (fatty) acid to which the catalyst is added in ammoniacal solution. Stannous hydroxide is said to be the preferred catalyst. Ferrous or cuprous hydroxides are also effective, but these have the drawback of discoloring the fabrics. The examples mention Dow Corning Silicone Resin 1107 (a methyl hydrogen polysiloxane) as an organosilicone resin. Ammonium salts of any soap producing fatty acid may be used as emulsifiers. The resins might be applied in amounts up to 10%. The catalyst tends to break the emulsion even in concentrations of about 1%, but this difficulty can be alleviated by adding some more emulsifier and at least 5% (in some cases 10-100%) stannic chloride (calc from the hydroxide's weight).

The inventors offer a theoretical explanation of the specific effect of the silicone emulsion containing the ammonium soaps and stannous hydroxide. During partial drying of the emulsion immediately after textile application, a large amount of ammonia evaporates and fatty acid is set free. This reacts partly with the stannous oxide to form an insoluble metal-fatty acid complex, which contributes to the water-repellent effect while producing no rewetting problem. As the emulsion is broken, an oily layer of the silicone resin is formed on the surface of the textile goods. This easily combines with the fatty acid-metal complex and promotes intimate contact of both components.

The emulsions are applied either by padding or by repeated passages through a jig. In the latter event, complete exhaustion, speeded up by the content of stannous hydroxide, may be attained. To avoid nonlevel exhaustion, one may add the metal hydroxide after an initial treatment with the emulsion. Drying and curing are said to occur simultaneously, at 100-130°F, even in air drying at room temperature.

Example: A resin solution of 50 g of the above-mentioned silicone resin and 7.5 g of myristic acid dissolved in 33 g of toluene and 9.5 g of perchloroethylene was added to an ammoniacal solution of commercial stannous hydroxide. A good emulsion was formed by stirring.

Among the references cited by the Patent Office:

USPat 2,588,366 (Dow Corning/1952) covers a method for the hydrophobing of textiles by the application of mixtures of methyl polysiloxanes and methyl hydrogen polysiloxanes.

Brit Pat 645,768 (Dow Corning/1950) covers a method for the hydrophobing of textiles by immersion in methylpolysiloxanes and methyl hydrogen polysiloxanes. The emulsifier is a quaternary ammonium salt, eg, tribenzyl methyl ammonium chloride.

(concluded on page 223)

BOOK REVIEW

MODERN CHEMICAL PROCESSES—Vol IV

Reinhold Publishing Corp
New York, NY, 1956
202 pages with 5 page index
$5.00

This volume is fourth of a series of monographs on the American Chemical Industry by the editors of *Industrial and Engineering Chemistry*. The format is very attractive with a profusion of illustrations, both pictures and diagrams.

Volume IV includes a series of articles that are each written by an editor in conjunction with one or several outstanding individuals associated with the industry being discussed. The nineteen recently developed chemical processes that are discussed are all treated in the same general way: "background, including commercial and technical history and the origin of the present installation; description of plant installation, including design details of nonstandard items; description of process and operation of plants; economics of process, including raw materials and processing cost breakdowns, plant investment and amortization; personnel; and future prospects, including technological improvement of the process and changes in the industrial picture."

To read this book, and it proves to be extremely readable, is to be reminded of the ever-growing colossus that is the American chemical industry. Each article speaks of major achievements and minor revolutions. Of particular interest to dye chemists is the chapter on Anthraquinone Dyes written by Kevin Bradley, asst editor, and Phillip Kronowitt of Ciba States Limited. This type of dye is the class that has experienced the most outstanding increase in production in the United States of all dyestuffs since World War II. Every phase of the commercial production of these dyes is covered in detail. Reaction equations, flow sheets, table and photographs go to make an exhaustive survey of the work being done at Toms River, NJ, by Ciba.—RJK

ACRIDINES (Vol IX—The Chemistry of Heterocyclic Compounds)

Interscience Publishers, Inc
New York, NY, 1956
409 pages; 18-page index
$12.50; sub price $11.25

Acridine was isolated from coal tar by Graebe in 1870 and correctly formulated by Riedel in 1883. Before Graebe's work, "Phosphine", an acridine ring system derivative, was on the market as a dyestuff. Today Phosphine and related acridine dyes have gone into practical disuse. However, a few complex vat dyes containing the acridine nucleus are still of importance today.

The renewed interest in the search for new dyestuffs as well as the discovery by biochemists of acridine derivatives in nature has stimulated further investigations into the chemistry of acridines.

This monograph is exhaustive in its bibliography, including references to the major journals up to June 1954. It is well indexed and many tables, including cross references, synthetic facts and physical constants make the book exceptionally useful. It would seem that the author, a member of the Department of Biochemistry at Oxford, had set out to create a useful, ready-reference book that is at the same time both concise and not short on the discussion of experimental findings and theoretical considerations. He has achieved this end very well. Chapter VII entitled "Visible and Ultraviolet Absorption Spectra of Acridine and its Derivatives", written for this monograph by L E Orgel, is the only chapter not written by the author.—RJK

CHEMICAL TRADE NAMES AND COMMERCIAL SYNONYMS—2nd Edition

William Haynes
D Van Nostrand Co, Inc
Princeton, NJ
vi + 466; $8.00
15.5 x 23.5 cm

Because of the widespread practice of using trade names in the chemical industry, it has become imperative to offer a convenient and up-to-date reference to laymen and technologists alike. This book admirably fits this purpose. The commercial synonyms of a chemical are listed as well as their trade names.

The terms listed are confined to chemicals and chemical specialties sold in the industrial field and does not include specialties sold to the general public. An index of manufacturers, including addresses, is part of this book, which should prove extremely useful to anyone seeking further information.—VL

Patent Digest———

(concluded from page 222)

GAS-FADING PREVENTION by Impregnating with Alkali Phthalates G,1

USPat 2,758,002 (Brit Celanese——Olpin et al ——Aug 7, 1956)

Among the numerous antifume agents suggested in the past, many products have a deleterious effect on the textile material itself; others are apt to become discolored themselves in gas fumes, thereby giving undesirable shades; and many of them also adversely affect the lightfastness of certain dyes, as may be observed especially with triethanolamine.

The current specification claims a general improvement of dyeings made with otherwise fume-sensitive dyes when an alkali phthalate is incorporated within the dyed material, for example, disodium phthalate. The phthalates are specific for this effect and by far superior to related compounds, eg, the sodium salt of naphthalic acid.

Obviously the effect of the readily water-soluble alkali pthalates is lost after the first washing process. Therefore, the current method is primarily important for applications on materials which are washed seldom or not at all, eg, furnishing fabrics. A special use was found in the treatment of mixed material consisting of cellulose esters and cellulosic, nonesterified components. With the use of direct dyes on such a material, the cellulosic portion will fade upon exposure to light when triethanolamine is used as the gas-fading preventor; when alkali phthalates are used as the gas-fading preventor, however, these shades are unimpaired.

Reference cited by the Patent Office:

USPat 1,914,945 (Celanese Corp of Am/1933) covers a method for improving the fastness of cellulose acetate dyeings to the combined action of acid and light. It involves the incorporation of salts having an alkaline reaction in general, eg, borax, disodium hydrogen phosphate, etc.

Abstracts

The Separation and Examination of Fiber Blends

Lindley, F W, *J Soc Dyers & Colourists 72*, 469-72, October, 1956.

There are various reasons for requiring to separate a blend of fibers, particularly as an aid to identification. The quantitative separation is most important. Some blends are easy to separate, others are difficult.

One method of wide applicability is the flotation method, which forms the subject of this paper. The essentials of the method are as follows: the fiber blend is chopped into small pieces, preferably not greater than 1 mm in length and then immersed in an inert liquid of density midway between the densities of the two fibers. The lighter fiber floats, and is decanted off and weighed; the heavier fiber is subsequently recovered and weighed.

A table is included, giving the sp gr of 31 natural and synthetic fibers, ranging from 1.14 for 6,6-nylon to 1.72 for calcium alginate.

The inert liquid employed consists of a mixture of xylene (sp gr 0.853) and pentachloroethane (sp gr 1.673) in suitable proportions to produce the density desired.

It is often advantageous to stain the fibers in contrasting colors, as a visual check on the degree of separation is thereby facilitated. Several suitable stains are described.

Where the density difference is of the order of 0.02 g/ml, the method consists in commencing with a liquid mixture which has a rather lower density than that ultimately required. Pentachloroethane is then added a few drops at a time, and the liquid centrifuged for a minute or so until the lighter fiber begins to separate. The centrifuging is then continued for 5 minutes longer.

Full details are given for carrying out the tests, and tables are included, showing how successful the method is in separating two fibers of almost identical densities.

Eight references to the literature are cited.—WHC

What Radioisotopes Can Do for Textiles

Pinault, R W, *Textile World* 107, 77-80, Jan, 1957.

The potentialities of radioisotopes in textile research and control are fantastic, according to the author. Tagged atoms incorporated into yarn lubricants, sizing formulas, bleach baths, dyebaths, coating mixtures and many other materials and processes can tell the processor exactly what is going on.

The beta-ray gauge, containing a minute particle of Sr-90, Cs-137 or Ru-106, is used to measure thickness of fabrics, primarily in coated materials. The gauge is mounted on the coating range, and the beta rays pass through the fabric and are measured on an ion chamber, which is described. The thickness of the material interferes with the transmission of the radiation.

Another textile application of radioisotopes, originating in England, is the inclusion in a print color of a few millicuries of P-32. As the run progresses, and before contamination of the following color is visible to the printer, Geiger counters announce the presence of the tagged color in subsequent color boxes.

In pad dyeing, in padding on resist salts or finishes, or in coupling naphthol colors, a radioactive tracer in the pad liquor helps materially in noting variations in the solution and the amount of dyes or chemicals deposited on the goods.

A lubricant applied to synthetic-fiber yarns in the initial spinning process should be uniformly deposited for best results. With the addition of a trace of radioactive bromine to the oil and measuring the radiation from the oiled yarn, a standard can be set up and variations easily detected.

By mixing Ca-45 with a soiling medium applied to test fabrics, the efficiency of various detergents can be checked to a degree hitherto impossible. As long as traces of the soil remain, Geiger counters will react to the even fainter traces of Ca-45.

Where fabrics are to be finished with water repellents, all traces of wetting agents, penetrants and the like that have been used in processing should be removed. Such auxiliaries, if tagged, are detectable in amounts far less than those that would interfere with a good water-repellent job.

Because radioisotopes are admittedly dangerous to handle carelessly, only qualified personnel are permitted to work with them and only in laboratories equipped for the purpose.

The author describes research work on the use of radioisotopes now in progress at NC State College and the Clemson College School of Textiles. In other research centers, more work is going on. The Japanese have found that by irradiating their synthetic-fiber Vinylon, its resistance to heat can be increased from 120°C to 200°C. Gamma rays from Co-60 or deuterons from a cyclotron will do the trick. Studies on the effect of radiation on the cotton fiber are now going forward at MIT.

Several references to the literature are cited.—WHC

Reactive Dyes

Vickerstaff, T, *Dyer* 116, 855, Nov 23, 1956.

Dyestuffs that react with cellulosic fibers are discussed by the author. His firm (ICI) recently introduced three dyes, known as the "Procion" dyes, which definitely react with cellulose under simple conditions in a mildly alkaline solution.

He offers the following proofs that there is a reaction with the fiber: 1) if a Procion dye is applied both with and without alkali, the dye is later removed by hot water where no alkali was used, whereas the dyeing with alkali is fast; 2) the Procion dye is not stripped with solvents, like other dyes; 3) the cellulose fiber after dyeing is no longer soluble in cuprammonium solution.

He states that the molecules of the Procion dyes consist of three parts: the colored organic compound, sulfonic acid groups, and a halogen atom, which reacts with the hydroxyl groups of the cellulose. This reaction is almost instantaneous, he says.

Dyeing is best carried out at low temperatures. The pad-steam technique is suitable for a continuous method. For batch dyeing it is recommended to add the alkali after the first half hour.

For printing, carbohydrate thickeners cannot be used because of reaction with the dye. Sodium alginate appears to be the only alternative. Sodium bicarbonate is added to the paste, and during steaming this is converted into carbonate, causing the dye to react with the fiber. In another printing method. the dve is first applied without alkali and the fabric is then padded with thickened sodium carbonate and dried without aging.

As the dyes are not stable to strong reducing agents they cannot be printed with vat dyes; also acid aging is not permissible.

The author believes that this is only the beginning of a new field opening up to dyers, and he predicts a vast extension.—WHC

Some Investigations into the Application of Dyes to Acrylic Fibers

Kramrisch, B, *Dyer* **116**, 967, Dec 7, 1956.

The author points out that Orlon 81 (filament) is difficult to dye and is not widely used in textiles. Orlon 42 (staple), Courtelle, and various Continental fibers of a similar type all have similar dyeing behavior. Acrilan has an advantage over these, he says, as it can be dyed with wool dyes by the usual wool-dyeing techniques.

Acrilan and Orlon 42 may be dyed with most disperse dyes. The washfastness is good; the lightfastness varies with different dyes. There is no trouble with gas-fading.

Basic dyes show good yield and brightness and unexpectedly good lightfastness. A new family of modified basic dyes (Deorlenes) is said to have even better fastness. Incidentally, Perkin's Mauveine is applicable to acrylic fibers, and is faster to light than on cotton.

The author states that while Orlon 42 can be dyed with acid dyes only by the "cuprous-ion" and analogous techniques, Acrilan can be dyed with a wide range of acid dyes. The Neolan- and Cibalan-type dyes are applied to Acrilan at a low pH. The Cibalans are used mostly for light and medium shades. Many chrome dyes are also suitable for dyeing this fiber, particularly for full shades.

Acrilan-wool unions may be dyed with selected acid, Neolan and Cibalan dyes. In the case of Orlon 42-wool unions, the Orlon is dyed with basic dyes and the wool cross-dyed later.

The acrylic fibers are noted for their soft hand, good blending properties, and high resistance to degradation on exposure to sunlight.—WHC

Properties and Possibilities of Polyvinyl Alcohol Fibers

Dorset, B C M, *Textile Mfr* **82**, 636-43, Dec, 1956.

During the past 20 years the possibilities of polyvinyl alcohol as a textile fiber have been almost continuously exploited in Japan, and today under the trade name of "Vinylon" it is, in that country, an important synthetic fiber. One indication of its possibilities in this field is that it can be produced stronger than nylon, say with a tenacity exceeding 10 g/d, yet having a more hydrophile character, and so more closely related to the natural fibers such as cotton and wool.

Although polyvinyl alcohol fibers are now being manufactured on the large scale, mainly in Japan (about 30 million lbs per annum at present), and have proved satisfactory in all stages of textile manufacture in giving strong, elastic, durable, dyeable and attractive fabrics and garments, there are yet several difficulties requiring research.

The author describes the process of manufacturing the fibers, and states that the extruded filaments at first are water-soluble. When stretched and dried at high temperatures they become insoluble in cold water, but are still sensitive to hot water. A further treatment with formaldehyde, forming methylene cross-linkages on the linear molecules, makes the fiber insoluble in boiling water. If the formaldehyde is replaced by higher aldehydes or ketones (containing at least 4 carbon atoms), the fibers are said to have still further resistance to water and heat and a higher elastic recovery. Still other treatments to improve the properties are described by the author.

The Vinylon fiber softens at 220°C; its sp gr is 1.0-1.2; it is resistant to insects, mildew and bacteria. It has a high resistance to abrasion. The usual tenacity is about 3 g/d, but it can be increased to 6-8 g/d. It is unaffected by a wide range of chemicals; only concentrated sulfuric acid dissolves it, while strong caustic soda only discolors it.

Some defects of the Vinylon fibers now being produced include their liability to creasing; a certain resistance to penetration by dyes, which hinders the production of deep shades (although a wide range of ordinary dyes can be used in coloring Vinylon goods); and a tendency for the fibers to shrink under hot, wet or damp conditions. These shortcomings are now the subject of further investigations.—WHC

The Vapacol Dyeing Process

Garrett, D A, *Dyer* **116**, 693, October 26, 1956.

The author describes a "new approach to the continuous dyeing of acetate, triacetate, and Terylene fiber", in which trichloroethylene vapor is used as the dyeing medium.

The process consists in padding the fabric with an aqueous dispersion of a disperse dye, drying, and immersing in a tank filled with the solvent vapor for a short time (in some cases, only 30 seconds). It has been found that dry Terylene, when exposed to saturated trichloroethylene vapor at 87°C absorbs 35% of the solvent by weight. This solvent so absorbed dissolves the disperse dye padded on the fabric, which diffuses rapidly into the fibers, producing "marked levelling action".

After the vapor immersion the fabric is raised to the boiling point of the solvent by a hot-air or hot-water treatment, to remove the absorbed vapor.

Advantages of the process, according to the author, are the short dyeing time required, good color yield, and uniformity of dyeing. The cost is said to be low, due to the high recovery of the solvent.

It is pointed out that the process is still in the pilot-plant stage.—WHC

The Laundering of Textiles Made from Man-Made Fibers

Viertel, O, *Textile Mfr* **82**, 589-92, November, 1956.

This instructive article discusses first the three principal factors in washing: a) the dirt and its composition; b) the material washed; c) the cleanser used.

Dirt's components are silicate pigments (eg, sand), soot, etc, as well as natural humus, mixed with skin fat, sweat and dead skin.

The material in washable clothing consists of cotton, linen, rayon, acetate, nylon, Orlon, Dacron, etc.

The structure of the cotton fiber is such that dirt clings to it. By comparison, smooth fibers like the synthetics give the dirt particles practically no hold, so that the lightest washing is sufficient to get the material clean. This easy washing quality of textiles made from synthetic fibers has led to the notion that it is sufficient to rinse and squeeze out in cold water nylon and Perlon stockings, underwear, etc, worn during the day. This, however, is not the case, for washing is not as easy as that, says the author. The dirt mixed with human fat is not removed with cold water alone. Such articles (eg, ladies' stockings) should be washed in lukewarm water with the addition of a gentle cleanser. Also, textiles made from synthetic fibers should not be worn too long or allowed to get too dirty before washing.

The author gives the results of repeated washing tests, made on Perlon shirts worn for two days before washing, as follows: 1) washed with a neutral cleanser containing an "optical bleach" at 35°C; 2) washed with soap containing perborate and soda (pH 10.6) at 60°C; 3) washed with a synthetic detergent containing perborate without soda (pH 9.8) at 70°C.

His conclusion is that articles of clothing that come in contact with the skin and are exposed to heavy soiling, when made of synthetic fibers, are best washed at 60-70°C (no higher) with an "orthodox" commercial detergent (for white articles) to get the best results without excessive rubbing.

The removal of skin fat demands somewhat higher temperatures and a certain alkaline condition not available when washing in lukewarm water with a neutral cleanser. —WHC

The Identification of Vat Dyes

Derrett-Smith, D A and Gray, J, *J Soc Dyers & Col* **72**, 211-27, May, 1956.

The tables on this subject published in 1940 and 1947 by the first-named author and his associates have been brought up to date by including all the British, German and Swiss vat and solubilized vat dyes that have appeared on the British market since 1940. Although no American brands are listed, most American dye chemists will recognize the various types by their foreign names.

The tables list 314 different dye names, grouped together according to constitution, and in parallel columns the color reactions of dyeings on cellulose when treated with alkaline and acid hydrosulfite, nitric acid, sulfuric acid, and in some cases, permanganate (where the other reactions are not sufficient). An alphabetical list of all the dye names follows.

The authors point out that the color produced with hydrosulfite and caustic soda at the boil is in some cases quite different from that obtained with hydrosulfite and sodium carbonate.

These tables should prove very useful. —WHC

Verel Acrylic Fiber: Physical and Chemical Aspects

Coover, H W, Jr, *Modern Textiles* **37**, 68-71, November, 1956.

The Verel fiber, introduced by Eastman Chemical Co, is available in four types: Regular, Type 1, Type 2, and FR. Regular Verel fiber has 0 to 2% shrinkage in boiling water, Type 1 has medium shrinkage, and Type 2 has high shrinkage. Verel FR is characterized by its outstanding flame resistance.

The author describes the principal physical properties of the fiber, including a tenacity of 2.5-2.8 g/d, an elongation of 33-35%, medium elasticity, and a softness similar to wool. It is thermoplastic and should not be ironed above 300°F.

Verel has a moisture regain of 3.5-4.0% (at 70°F and 65% r h) and a sp gr of 1.37. It has less tendency to form static than other acrylic fibers, and is non-allergenic.

Regular Verel has good flame resistance, while Type FR is believed to be the most flame-resistant organic fiber known to man. It is said to pass all known fire tests and ranks with glass and asbestos.

The fiber has good weathering characteristics, being better than any of the natural fibers and most of the synthetics. It is also resistant to a wide range of chemicals, including mineral acids, alkalis, and most common organic solvents, as well as microorganisms. Finally, it is said to have good recovery from wrinkling and a low pilling tendency.—WHC

Verel Acrylic Fiber: Its Dyeing and Finishing Properties

Ivey, William R, Jr, *Modern Textiles* **37**, 71-2, November, 1956.

Verel is a fiber that may be dyed by any dye house that is equipped to process man-made fibers and without the need of any special equipment.

Desizing is necessary to insure against unlevel dyeing. It is scoured with a neutral detergent, with addition of a mild alkali if necessary, but is discolored by strong alkalis. The fiber is quite white and does not normally require bleaching, but if necessary, sodium chlorite may be used. Peroxide and chlorine are not recommended.

The most important dyestuffs are the neutral premetallized dyes. The next best are the disperse dyes, producing brighter but less fast shades. Basic dyes are used when extra brightness is required. A temperature of 180-205°F is recommended for the dyebath. Heavy shades require a dyeing assistant to obtain proper exhaustion of the bath.

Verel may be blended with other textile fibers, eg, rayon, cotton, and wool, producing a variety of color combinations.

In finishing fabrics containing Verel, certain precautions should be observed. Resins should not be used, since they produce an undesirable stiffness, and any temperature over 300°F must be avoided—WHC

Evaluation of Verel Fiber

Earnhardt, C F Jr, *Can Textile J* **73**, 57-60, November 16, 1956.

The author describes the various functional properties of Verel which lend themselves to selected end uses, such as pile-type fabrics and man-made furs. In the knit goods field, the fiber is recommended for use in blends with cotton for underwear, sport shirts, etc. Blends of Verel with wool in men's wear are said to have good crease retention and wrinkle recovery.

In regard to dyeing, the neutral premetallized wool dyes provide good fastness to washing and light. Medium and light shades are dyed by standard methods, but heavy shades require a dyeing assistant to obtain complete exhaustion.

Disperse dyes are applied in the same manner as on acetate. To obtain brilliant shades, certain basic dyes may be used.

Blends of Verel and rayon are dyed in solid shades with combinations of neutral premetallized or acetate dyes on the Verel and direct dyes on the rayon. Either fiber may be left white if desired, or the two fibers may be dyed in different shades.

Blends of Verel and wool can be dyed in solid shades with neutral premetallized dyes, while selected acid premetallized dyes will leave Verel white, it is said.

Blends of Verel and acetate are dyed with disperse dyes, while blends of Verel and nylon are dyed with selected neutral premetallized dyes.

The author gives brief instructions for the finishing of fabrics containing Verel, and concludes with a table showing the resistance of the fiber to a long list of chemicals and organic solvents.—WHC

Verel's Physical Properties

Crawford, R T, *Can Textile J* **73**, 56-7, November 16, 1956.

Verel, Eastman's modified acrylic fiber, by virtue of its unique chemical composition, possesses a number of physical characteristics which should prove to be of particular interest to many phases of the textile industry, according to the author. These properties include a soft hand, ease of dyeing, high resistance to flammability, a white color in its natural state, controllable shrinkage, excellent chemical resistance, and a relatively high moisture content. It is offered in staple form, in 2 to 8 deniers per filament, and can be made either bright or dull. The tenacity is 2.5-2.8 grams per denier, the sp gr is 1.37, the moisture regain is 3.5-4.0% and the wrinkle recovery and crease retention are good. The maximum ironing temperature is 300°F. It can be furnished in either unstabilized or heat-shrunk form.

The fiber is highly resistant to mildew and microorganisms, and such varied chemicals as hydrochloric and nitric acids, drycleaning solvents and caustic soda have little or no effect.

It blends with wool, rayon and cotton, and by careful blending of unstabilized and heat-shrunk staple fibers it is possible to produce bulk yarns.

Because of Verel's inherent whiteness it is not necessary to bleach it. The dyes that may be used include the neutral premetallized, disperse, neutral acid and in some cases cationic (basic) dyes.

Fabrics containing Verel when properly controlled through dyeing and finishing exhibit excellent dimensional stability, the author states. Resin treatments are unnecessary except when Verel is blended with cellulose.—WHC

News of the Trade

Aerial view of FMC's Westvaco Chlor-Alkali Div plant at South Charleston, W Va

FMC to Increase Solvents from South Charleston

A multimillion solvent expansion program is being undertaken at Food Machinery & Chemical Corporation's largest chemical installation, the Westvaco Chlor-Alkali Division plant at South Charleston, West Va. Franklin Farley, Division president, has stated that the expansion involves carbon bisulfide and carbon tetrachloride, two major Chlor-Alkali products.

Engineering work on the solvent expansion program has already begun. The present bisulfide unit, built in 1954 and considered one of the most advanced in the world, will be substantially expanded. The somewhat older carbon tetrachloride unit is to be revamped completely to give more capacity and greater operating efficiency.

The solvent expansion program is part of an overall plan to renovate and enlarge most of Westvaco's South Charleston facilities. Other phases of the program include the entirely new ammonia plant completed in late 1955 and the rebuilding of the chlorine plant now in progress. Modernization of the steam and power facilities, including installation of modern fly ash equipment, is also under way.

Carbic to Handle Hoechst Line

Carbic Color & Chemical Co, Inc, New York, effective May 1, 1957 will be the sole selling agent for the Anthrasols (soluble vats), Hostagens (stabilized azoics), Hostavats and other specialties manufactured by Hoechst Chemical Corp, West Warwick, RI. Both companies are affiliated with Farbwerke Hoechst AG Frankfurt-Hoechst, West Germany.

Hoechst Chemical Corp is the new name of the former Metro Dyestuff Corp. H Grimmel, president, announced that the change was made in order to give recognition to the company's greatly enlarged scope of activities and affiliation with Farbwerke Hoechst AG.

Carbic Color & Chemical Co, Inc is a distributor of all the dyestuffs and textile chemical specialties manufactured by Farbwerke Hoechst AG, and is also the distributor in the USA and Canada of the manufactures of Durand & Huguenin, SA of Switzerland, which firm produces the Indigosols, Novochromes, and Aluminum Colors. Carbic Color & Chemical Co, Inc is also the sole selling agent in the USA and Canada for the Mayvats manufactured by Otto B May, Inc.

Berkshire Color & Chemical Corp Celebrating 25th Year

Berkshire Color & Chemical Corp, Springfield, Mass, is currently celebrating the 25th year of its founding in 1932 by its president, Floyd F Warshaw, to manufacture and distribute chemical specialties and dyestuffs to the textile, paper and tanning industries.

Modern facilities for the production of a wide range of specialty chemicals are located at 210 Albany Street, Springfield. This plant also serves as a shipping point for dyestuffs, chemicals and processing materials for New England and New York State.

This organization is also the New England distributor for colors produced by Berkshire Color & Chemical Co, Delawanna, NJ, which is headed by Elmer C Warshaw. Berkshire of New Jersey manufactures a wide range of aniline dyes in Delawanna and at its newly acquired plant in Reading, Pa.

MCA to Hold Air and Water Pollution Abatement Conference

The 1957 Air and Water Pollution Abatement Conference will be held in Washington, DC, April 4-5, under the sponsorship of the Manufacturing Chemists' Association. The two-day meeting will be staged at the Shoreham Hotel with public and regulatory officials and representatives of industry invited.

The program will consist of morning and afternoon sessions on Thursday, April 4 and a morning session on April 5. Prominent luncheon speakers have been scheduled for both days. On the opening day Harry Ballman, executive secretary of the Air Pollution Control Association, will speak on, "The Challenge of Air Pollution Control." The following day Ralph E Fuhrman, executive secretary of the Federation of Sewage and Industrial Wastes Associations, will discuss, "Cooperation in Water Pollution Control."

Among the subjects to be reviewed at the air-pollution-control session is an evaluation of the statutory approaches to the problem. Two members of the North Carolina Stream Sanitation Commission are scheduled to discuss the water-pollution-control problem.

PTI Alumni Hold 56th Annual Banquet

Frank E Masland, Jr, renowned traveler and explorer, and president of C H Masland & Sons, carpet manufacturers, Carlisle, Pa, was the guest speaker at the fifty-sixth annual banquet of the Alumni Association of the Philadelphia Textile Institute, held at the Bellevue-Stratford Hotel, Philadelphia, on Friday evening, March 1, 1957.

Mr Masland presented and narrated an exciting film covering his journeys down the Colorado River, of which he has made four, qualifying him for membership in the exclusive order of "Colorado River Rats."

Frederic H Barth, president, Industrial Rubber Company, Philadelphia, Pa, and PTI Alumni Association president, served as toastmaster for the ceremonies.

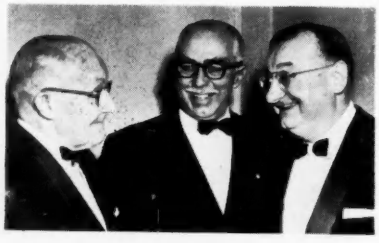
Bertrand W Hayward, president of the Institute, gave his annual address preceding the showing of Mr Masland's film.

He gave a summary of developments at the college during the past year including mention of the addition to the Hesslein Library, for which ground was broken earlier in the day; the purchase of the four acres of ground for future expansion of facilities; the interest on the part of the Garment Manufacturers of Philadelphia in incorporating into the day and evening school courses in Garment Manufacturing; the apparently very successful special courses set up for J P Stevens Company, the knitting industry, the American Association of Textile Chemists and Colorists and the Du Pont Company.

Leon P Brick, president, Intex Chemical Corp, Lodi, NJ, and fund chairman of the Alumni Association, gave a report of the annual giving program to date.

Many classes held individual informal get-togethers at what was the best-attended Alumni Banquet in the history of the Institute.

The PTI Men's Choir, directed by Louis Doelp, sang four selections.



Richard S Cox, dean emeritus, PTI, (left), Frank E Masland, Jr, guest speaker, and Frederic H Barth, PTI Alumni Association president, converse at the 56th annual PTI Alumni Banquet.

William Price, librarian at PTI, breaks ground at ceremonies for the extension of the Institute's library as Frederic H Barth (left), PTI Alumni Association president, and Howard N Smith (right), representative of the Hesslein Foundation, look on. Pictured in the background are officials and trustees of the Institute.

Approximately fifty people braved the rain and sleet to attend the ground-breaking ceremonies for the new wing of the Hesslein Library.

Howard N Smith, representative from the Hesslein Foundation, donors of the original library; W Lyle Holmes, Jr, chairman of the Board of Trustees of the Institute, and president of Archibald Holmes and Sons, Inc; William Price, librarian at the college; Richard S Cox, executive secretary of the PTI Foundation; and President Hayward took part in the ceremonies by making brief remarks in connection with the need of the addition and each took a turn in upearthing a spadeful of soil.

The construction of this wing will relieve the crowded condition that exists in the library and is in compliance with the recommendation made by the Middle States Association of Colleges and Secondary Schools in 1955 when PTI became accredited by this group.

New Printing— "Fabric Defects"

J B Goldberg, consultant to the textile and allied industries, has announced a third printing of his book, "Fabric Defects". This book, which describes case histories of imperfections in woven cotton and rayon fabrics, has been out of print for the past year and is again being made available. The original publication price of $6 is being retained and copies may be ordered directly from the author at 11 West 42nd Street, New York 36, NY.

New "Flusher" Expands H-D Production Capacity

Installation of a new 350-gallon "flushing" machine—the third of this capacity to be put into operation in the past 12 months—has been announced by Harold Hansen, vice-president of Sterling Drug Inc in charge of The Hilton-Davis Chemical Co Division, Cincinnati, O.

Purpose of the additional equipment, he explained, is to increase the company's productive output of flushed colors in response to growing industrial demand.

In flushing, the individual pigment particle, surrounded by water, is carried from its original finely divided state into the vehicle, or oil, phase without destroying its minute, uniform size. The result, it is stated, is a finer dispersion of pigments than possible by grinding, with consequent greater strength, higher gloss and cleaner, sharper colors.

Arthur J Schroeder is director of pigment production at Hilton-Davis. Flushing units under his supervision include those with 1000-gallon capacity, 350 gallons, 225 gallons, as well as smaller equipment.

Industry Leaders Speak at "Minimum Care Fabrics" Symposium

An outstanding group of industry leaders shared the speaker's rostrum at the symposium on "minimum care fabrics" sponsored by the Textile Section of the New York Board of Trade on February 28th, at the Sheraton Astor Hotel. Cameron A Baker, US Testing Co, served as chairman of the event.

Among those who addressed the meeting were: Sydney Cone, president, Textile Research Institute, and vice president, Cone Mills Corporation, speaking on "The Engineering Aspect of Using Natural Fibers in the Minimum Care Fabrics"; Percy J Fynn, director, Research and Textile Laboratory, J C Penney Co, Inc, speaking on "Garment Manufacturers' Aspect of the Minimum Care Fabric"; Paul Stam, director of research, Burlington Industries, speaking on "Finishing Fabrics of Natural Fibers for Minimum Care"; William P Wright, Jr, vice president, J Walter Thompson Company, speaking on "Merchandising, Sales and Advertising Minimum Care Fabrics"; Arthur Duske, Brooks Brothers, speaking on "Garment Manufacturers Utilizing Minimum Care Fabrics"; John H Dillon, director, Textile Research Institute, speaking on "Relationship of Fiber Properties to the Development of Minimum Care Fabrics"; J B Goldberg, chemical engineer and consultant, speaking on "The Fabric Engineering Aspect of Using Man-Made Fibers in the Minimum Care Fabrics"; and Julius Hermes, vice president, Fontaine Converting Company, Inc, speaking on "Finishing Fabrics of Man-Made Fibers for Minimum Care".

A panel consisting of several prominent individuals from the user and service phases of the industry also discussed and answered questions concerning "minimum care" fabrics following the program of addresses.

Elmo International to Handle Comerio Ercole Line in US

Elmo International, PO Box 222, Woodcliff Station, North Bergen, NJ, headed by M Vallen, has been appointed the exclusive sales agents in the USA for Comerio Ercole SpA of Busto Arsizio, Italy, manufacturers of dyeing, screen and roller printing, and finishing equipment.

Since 1885, Comerio Ercole SpA has been one of Europe's leading textile machinery manufacturers, serving the textile industry throughout Europe and other parts of the world.

The Comerio Ercole line includes machinery for bleaching, mercerizing, dyeing, screen and roller printing, and all finishing processes.

Illustrated literature on the complete line may be obtained by writing to Elmo International at the above address.

Swiss Industries Fair

The annual Swiss Industries Fair, to be held April 27-May 7, will have among the wide range of articles to be displayed many entirely new products of interest to the textile and chemical industries.

In the field of textile and wearing apparel, the exhibits will be highlighted by two special displays entitled "Creations" and "Madame-Monsieur".

Several new developments in textile machinery, including a "shuttleless automatic ribbon machine", are expected to attract widespread interest.

Full information on the Fair may be obtained from H W Gasser, the office of the Consulate General of Switzerland, 444 Madison Ave, New York 22, NY.

AF Webbing Research Contract to FRL

The effect of webbing structure on the load, elongation, and abrasion resistance of present Air Force synthetic fiber webbings will be investigated by Fabric Research Laboratories, Inc, under a research contract sponsored by the Air Materiel Command, Wright-Patterson Air Force Base, Ohio. Attempts will be made to design webbings with increased strength to weight ratios and improved abrasion resistance.

Previous development programs in webbings have been concerned with strength requirements or specific width and thickness requirements. In the new contract, geometric parameters, such as denier, twist, ply, ends, weave, picks per inch, and dyeing as they affect the weight, thickness, strength, and abrasion resistance of nylon webbings will be studied. Special emphasis will be on designing a series of nylon webbings with increased strength to weight ratios and improved abrasion resistance.

Webbing dyeing techniques will be investigated to determine the effects of piece dyeing and yarn dyeing on webbing geometry.

Ernest R Kaswell, Milton M Platt, and Myron J Coplan, FRL directors, will serve as advisors on the research, and Chauncey C Chu, senior research associate, will serve as project leader. The project engineer for the Air Force is Robert Wilkinson.

Becco Research Lab Completes Report No. 10,000

Recently, a two-page typewritten report, accompanied by three hand-lettered charts on graph paper, slipped quietly into the permanent file of the Research Laboratory of Becco Chemical Division, Food Machinery and Chemical Corporation, Buffalo, NY. Its title: "Investigation of Breaks in Bleached Cotton Thread."

Its serial number, however, gave this report an added significance that set it a little apart from the preceding one. The number: 10,000, an impressive milestone.

From the company's very beginning in 1925, as the Buffalo Electro-Chemical Company, a continuing program of research and development has investigated industrial processes that used or could use the hydrogen peroxide and other peroxygen chemicals that Becco makes. The common goal of these investigations was a better, more economical process for one or more of Becco's customers.

Initially, the research concentrated on the application of hydrogen peroxide to textile bleaching and to pulp and paper brightening. As Becco's product-line grew, its field of investigation widened. The size of its research staff has steadily increased, too—from the original *one* to more than 60 today.

The findings of these researchers were recorded, in the usual way, as "Laboratory Reports."

Some of these reports were deemed of broad enough usefulness to be published; first as articles in the technical journals and trade press, later as Becco Bulletins. Others were destined to be seen by no more than a dozen pairs of eyes.

The titles of these reports indicate the breadth of interest of Becco's researchers:

An early report, for example, was No. 127, entitled: "The Bleaching of Bag Material."

In 1938, Report No. 602 covered a research project devoted to finding out: "The Fastness of Vat Dyes to H_2O_2."

In 1945, another report disclosed, for the first time, the successful development, on a commercial scale, of 90% hydrogen peroxide.

Any day now, Reports No. 10,001 and 10,002 will come along. But until No. 100,000 arrives, the laboratory people at Becco will always feel a little extra proud of Report No. 10,000.

• NEW PRODUCTS AND DEVELOPMENTS •

Lanasyn Bordeaux GRL

Lanasyn Bordeaux GRL is a new addition to the Sandoz line of neutral-dyeing premetalized dyes for wool, nylon, and silk. The lightfastness of this dye is said to be excellent on wool, and even higher on nylon. Waterfastness tests reportedly indicate that it meets all requirements for the dyeing of automotive fabrics. Under conditions of alkaline milling, it is said to prove itself a very superior color. It is stated that, since crocking tests on material dyed with Lanasyn Bordeaux GRL show excellent ratings for wool and nylon, it is especially suitable for use on decorative fabrics.

Chrome Fast Red NL

Francolor Inc, Woonsocket, RI, in announcing the availability of the brightest of all its chrome reds, Chrome Fast Red NL, cites the following characteristics for the product: 1) excellent solubility, 2) very level dyeing properties, 3) ease of chroming, 4) excellent wetfastness, and 5) very good lightfastness.

In view of these qualities, Francolor recommends its use for very fast mode shades with Chrome Fast Yellow JR (Pr 1) and Chrome Fast Grey JL (Pr 299).

Chrome Fast Red NL reportedly reserves cotton and acetate and yields on nylon excellent wetfast and very good lightfast bright yellowish reds.

Fashion shades may be obtained by combining Chrome Fast Red NL with colors listed on page 13 of Francolor's Technical Notice 55-E.

It is also recommended for use in vigoureux printing.

Carbanone A

Hart Products Corp, 1440 Broadway, New York, NY, has announced the development of Carbanone A, a nonionic-anionic surfactant which is said to combine the best features of the anionic and nonionic classes of detergents.

Carbanone A is said to exhibit the excellent solubility, detergent, wetting and dispersing properties of soaps, while maintaining the high stability to acids, alkalies and hard water salts characteristic of the nonionic ethers.

Hart Products recommends Carbanone A for all scouring and wetting applications on cottons and synthetics, particularly where hot acid or alkaline conditions prevail, such as in kier-boiling and carbonizing. It is claimed to have excellent rinsability and, containing no sulfur compounds, a low degree of corrosion on equipment. The new product is said to be a powerful dispersing agent for the disperse dyes.

Carbanone A is available as a highly concentrated gel of light color.

Arctic Syntex 036

Colgate-Palmolive Company has announced the addition of Arctic Syntex 036, a new 100-percent-active, nonionic detergent, to its line of industrial products.

The unique properties of this new liquid detergent are said to make it compatible with a variety of solvents and other chemicals and, as a result, it is claimed to be an ideal detergent for textile and other industrial uses.

Arctic Syntex 036 can be used effectively wherever an economical and efficient wetting, penetrating, emulsifying and cleaning agent is desired, according to Colgate's Industrial Department. It reportedly is not inactivated by acids, alkalies, oxidizing or reducing agents, or by most organic ions.

Arctic Syntex 036 is recommended by Colgate for general application—where grease or oil removal is a problem; in acid or alkaline solutions where other surface-active agents may be inactivated; in hard water or in solutions of metal salts, and in combination with other anionic and cationic agents and other surface- and nonsurface-active agents.

Colgate's new Arctic Syntex 036 is available in 50-pound pails and in 460-pound drums. Further information may be obtained from Industrial Sales Department, Colgate-Palmolive Company, 300 Park Avenue, New York 22, NY.

Nacconate 310

Nacconate 310, dimethyldiphenylmethane diisocyanate, is now available in developmental quantities from National Aniline Division, Allied Chemical & Dye Corporation, 40 Rector St, New York, NY. This new Nacconate is said to be unique in that it forms relatively stable water emulsions, has an unusually low reaction rate and low vapor pressure.

National Technical Bulletin I-17F gives six pages of detailed data on Nacconate 310 covering structural formula, analysis, properties and suggested uses. It also includes an infrared spectrogram, vapor pressure curve and a chart showing the reactivity rates of Nacconate 310 in comparison with Nacconate 300 and Nacconate 80.

General Calendar

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
Gordon Research Conference on Textiles, July 8-12, Colby Jr College, New London, NH

AMERICAN OIL CHEMISTS SOCIETY
Spring, 1957 (Spring meeting, New Orleans); Sept 30-Oct 2, 1957 (Fall meeting, Cincinnati); Apr 21-23, 1958 (Memphis); Oct 20-22, 1958 (Chicago); Spring, 1959 (New Orleans); Fall, 1959 (Los Angeles).

AMERICAN MATERIAL HANDLING SOCIETY
Apr 29-May 3 (7th Materials Handling Exposition, Convention Hall, Philadelphia, Pa)

THE DRYSALTERS CLUB OF NEW ENGLAND
Apr 26 (Hotel Vendome, Boston); June 21 (Annual Outing—Wachusett Country Club, West Boylston, Mass).

THE FIBER SOCIETY
Spring Meeting—May 1-2, 1957, The Clemson House, Clemson S C; Sept 4-6 (Joint meeting with the Textile Institute—Hotel Statler, Boston, Mass)

NATIONAL ASSOCIATION OF HOSIERY MANUFACTURERS
NATIONAL KNITTED OUTERWEAR ASSOCIATION
UNDERWEAR INSTITUTE
April 29-May 3 (1957 Knitting Arts Exhibition, Atlantic City, NJ)

NATIONAL COTTON COUNCIL OF AMERICA
October 2-3 (Chemical Finishing Conference—Statler Hotel, Washington, DC)

PHI PSI FRATERNITY
April 25-27—Annual meeting, New Bedford Hotel, New Bedford, Mass.

PHILADELPHIA TEXTILE INSTITUTE ALUMNI ASSOCIATION
June 6-8 (Alumni Day, Alumni Outing, PTI Commencement)

PURDUE UNIVERSITY
May 13-15 (12th Purdue Industrial Waste Conference, Purdue Univ, Lafayette, Ind)

SYNTHETIC ORGANIC CHEMICAL MANUFACTURERS ASSOCIATION OF THE UNITED STATES
May 26-28 (Annual Outing Skytop, Pa); June 11, Sept 10, Oct 8, Nov 12 (Palm Terrace Suite, Hotel Roosevelt, New York, NY)

TEXTILE QUALITY CONTROL ASSOCIATION
March 28-29 (Spring Meeting, Clemson House, Clemson, SC)

• NAMES IN THE NEWS •

Restrepo

Allan

Davis

Worth

Alco Oil & Chemical Corp, Philadelphia, Pa, has announced three new sales staff appointments and two additions to the research staff.

Robert P Restrepo, formerly plant superintendent for the Company's Philadelphia plant No. 1, has been named midwestern states field technical sales representative. **John M Allan,** formerly a technical sales representative in the Philadelphia office, has been named mideastern states field technical representative. **Leroy J Davis, Jr,** formerly with the U S Rubber Co and James Lees and Sons Co, succeeds Mr Allan in Philadelphia.

Robert A Martin has joined Alco as a group leader in chemical research in the field of acrylic latices, and **Daniel L Worth** will take up research work on problems of warp sizing. Mr Martin previously was a research associate at Squibb Institute for Medical Research. Mr Worth had been a textile chemist for the Chemstrand Corp.

James L Vaughan has joined the Dewey and Almy Chemical Company Division of W R Grace & Co as assistant research director in charge of process design and development. He will supervise process engineering, the firm's pilot laboratory, and part of product development research.

Mr Vaughan formerly was director of process engineering with the National Research Corporation, Cambridge, Mass.

The appointment by the board of directors of Allied Chemical & Dye Corporation of **Fred J Emmerich** as chairman of the board, and **Glen B Miller** as president of the Company, and other organization changes, were announced last month following the regular meeting of the board.

Mr Emmerich, president since July 1946, has over 36 years service with the Company. Employed in 1920, the year Allied Chemical was formed, Mr Emmerich became successively comptroller, vice president and president.

Mr Miller has been a vice president of the Company since 1950, and a director and member of the Executive Committee since 1953. His service with the Company commenced in what is now the Buffalo plant of the National Aniline Division. As president, he will be the chief executive officer of the Company.

The board also appointed **Carlton Bates, Frank L Linton** and **James Sheridan** as vice presidents, and **Lawrence A Coleman** as general counsel of the Company. **I H Munro** was appointed president of the Company's Solvay Process Division.

Mr Bates was formerly president, and Mr Munro vice president, of Solvay Process Division. Mr Linton, now comptroller of the Company, and Mr Sheridan, its treasurer and also president of Allied Chemical International Division, will continue to hold such offices. Mr Coleman has been head of the Allied Chemical Legal Division since 1951.

The Washington Chapter of the American Institute of Chemists has announced that its Honor Award for 1957 is to be presented to **Milton Harris**. director of research of The Gillette Company, at the annual banquet to be held on April 23 at the Windsor Park Hotel. Dr Harris is being cited for his outstanding services in advancing the professional status of chemistry, and for his leadership in research in the chemistry of textiles and high polymers.

Carbide and Carbon Chemicals Company, a Division of Union Carbide and Carbon Corporation, has announced the transfer of **E G Szela** to the Chicago District Sales Office. Mr Szela, who recently completed his training in the General Sales Office in New York, will take on the duties of a technical representative.

Riley

Burgoyne

Trubin

Ball

National Adhesives (Canada) Ltd has announced the following organization changes:

Norman Riley is moving to Montreal as manager of the Montreal Division and will be responsible for all operations at that point.

Gerald W Burgoyne becomes sales manager of the Montreal Division.

George L Trubin has been appointed production manager. In his new capacity, Mr Trubin will be responsible for manufacturing operations at National's Canadian factories, with headquarters in Toronto.

William D Ball has been assigned to the new post of supervisor of consumer products sales at Toronto.

Lawrence J Serkanic has been appointed chief of the protective coatings laboratory of Nuodex Products Company, a division of Heyden Newport Chemical Corporation.

Mr Serkanic replaces **Frank X Ritter,** who has been appointed regional sales representative.

Mr Serkanic was formerly technical director of Jamestown Finishing Products Company. Mr Ritter joined Nuodex in 1951 as a chemist and was appointed director of the protective coatings laboratory in 1954.

Robert H Meadows has joined Lowell Bleachery, Inc, St Louis, Mo, as assistant sales manager. He previously represented Kendall Mills and had production experience at Dan River Mills. He will headquarter in Chicago, Ill.

Levy

Photovolt Corp, New York, has announced the appointment of **Gabor B Levy** as a member of its management staff.

Dr Levy has been active in physical and analytical chemistry, instrumentation and laboratory management. He will concern himself primarily with development and applications research.

H Betts Wilson, assistant professor of textiles at Clemson College, is currently serving as a field representative between the textile industry of South Carolina and the Clemson College textile school, a service established at the suggestion of the advisory committee of the South Carolina Textile Manufacturers Association.

Mr Wilson will work to coordinate the industry's needs with the potential of Clemson textile students in all educational matters; to help the industry encourage more and better students to fill the growing demand for college-trained textile personnel; to establish practical summer employment for Clemson textile students and to coordinate the industry's research needs that can be met by Clemson College.

Mr Wilson was an inspector for the U S Government with the Philadelphia Quartermaster Corps for five years before joining the Clemson staff.

Brown

Alfred E Brown has been appointed director of research of Harris Research Laboratories, Inc, Washington, DC.

Dr Brown joined the laboratories in 1945, and has been assistant director for the past seven years. He has been most active in research and development activities involving protein fibers, such as hair and wool, in the cosmetic, textile and allied chemical fields.

KARL H SCHMATZLER

KARL SCHMATZLER, a member of AATCC for many years, died recently at the age of 52.

He was born Nov 26, 1904 and resided for many years at 8 Brier Rd, West Roxbury, Mass. He joined National Aniline Division on October 29, 1923, and served the Company for 33 years. Mr Schmatzler was located at the Boston Branch.

P DAYTON SWITZER

P DAYTON SWITZER, 59, a sales executive for American Cyanamid Co, died Feb 3. He had been with the Company's Dyestuffs Department since 1933, servicing the New York area.

Mr Switzer was born in Bellows Falls, Vt, and attended Norwich University. Prior to joining Cyanamid he had served as manager of paper mills in Vermont and Pennsylvania and as a sales technician for Bird Machine Company and Moore & White Company.

A former resident of Watertown, New York, Mr Switzer is survived by his wife, Laura Spaulding Switzer and his children Frederick and Laura Marie.

Wells

Fabric Research Laboratories, Inc, Dedham, Mass, has announced the appointment of **Richard D Wells** to the position of assistant director of the Laboratories, effective March 15.

Mr Wells comes to FRL after many years of active participation in textile science. He has been with the Bates Manufacturing Company in Lewiston, Maine, since 1946, where he has held the positions of director of quality control, director of research, and director of research and development.

Stein, Hall & Co, Inc, has announced that **Douglas Lowe** has been elected a director of Stein-Hall, Ltd, its Canadian subsidiary.

Mr Lowe, who joined Stein-Hall, Ltd in 1944, has served as the organization's technical director since 1951.

Neil F Winn has been appointed assistant to the manager of manufacturing of American Cyanamid Company's Industrial Chemicals Division.

Mr Winn joined Cyanamid in 1940 as a chemist at the Welland, Ontario plant, where he remained until 1946 when he was transferred to Bound Brook, N J, as a shift foreman and later department superintendent. Transferred to the Willow Island, W Va, plant in 1947, he was appointed assistant plant manager in 1954.

1957 KNITTING ARTS EXHIBITION

APRIL 29 - MAY 3

ATLANTIC CITY, NJ

•

THE 1957 KNITTING ARTS EXHIBITION NUMBER OF AMERICAN DYESTUFF REPORTER WILL BE PUBLISHED APRIL 22

ies, Inc.
ced the
Wells to
ector of
larch 15.
L after
pation in
with the
pany in
, where
director
of re-
rch and

nounced
elected
its Ca-

ein-Hall,
e organ-
ace 1951.

ppointed
anufac-
d Com-
Division.
in 1940
Ontario
ntil 1946
Bound
nan and
tendent.
Island,
vas ap-
ager in